UNDERSTANDING CHANGES IN POST-ADOPTION USE OF INFORMATION SYSTEMS (IS): A GENERALIZED DARWINISM PERSPECTIVE

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This dissertation is dedicated

to my mother

Louisa Tennant

A Mother's Love

"Your arms were always open when I needed a hug. Your heart understood when I needed a friend. Your gentle eyes were stern when I needed a lesson. Your strength and love has guided me and gave me wings to fly" [Sarah Malin]

Abstract

As organizations continue to invest heavily in Information Systems (IS) to support business processes, the underutilization of such systems is a key concern that challenges efforts to exploit their benefits. What is most desirable is for users to engage in forms of deep use that effectively leverage the features of the IS for work tasks. But, too often users engage in surface-level use, minimizing their interactions with the IS. Yet for many users how they use an IS changes over time to become progressively deeper as the IS is embedded more in the performance of various tasks.

To date there has been limited research on post-adoption IS use, particularly on how individuals choose to or are influenced to learn about, selectively adopt and apply, and then extend IS use. This research therefore seeks to bridge a gap in the literature by responding to calls for greater attention to changes in IS post-adoption use. This study draws on evolutionary theory, that is, Generalized Darwinism and its key principles of variation, selection and retention, to understand and explain how individuals' IS use change over time, as they enact routines supported by the IS.

Using a multi-method research design, this study includes an exploratory phase (qualitative) followed by a confirmatory phase (quantitative). For the qualitative phase, case studies were used to explore change in IS use; a cross-section of 39 users (i.e. basic, intermediate and advanced) of large-scale IS (e.g. CRM) from across three (3) organizations were interviewed. The findings from the qualitative phase coupled Generalized Darwinism principles of variation, selection and retention, supporting theories (e.g. motivation theory) and prior research in IS, were used to develop a conceptual model that framed changes in post-adoption use for further analysis. The model was then tested using data collected from a field survey (86 users) and analyzed using the Partial Least Squares (PLS) approach to structural equation modeling.

The study showed that variations occur as individuals used formerly unused (available) features, modified use of currently used sets of features, substituted or replaced one (already-used) feature with another feature and found novel or innovative uses of IS features. There were also a number of similarities in the findings from the case study and the survey regarding the triggers and enablers of variations and the impact of variations on retention, and in turn the impact of retention on deeper use via emergent use, integrative use and extended use. Both the case studies and the survey confirmed the importance of feedback valence, intrinsic motivation, and domain-related knowledge and of key sub-dimensions such as intrinsic motivation to learn, knowledge of IS features and work process understanding as triggers of variations. Satisfaction, in addition to variations was also instrumental in determining which variants in use were selected and incorporated into one's work routine (retention). Furthermore, the results suggest that as changes occurred over time, such changes

resulted in more deeply ingrained use behaviours, by way of infusion. At the same time, some differences were observed among the case studies and between the case study outcomes and the survey findings, with some of the factors identified as important in the case findings, such as peer learning, extrinsic motivation, and perceived (IS) resources, not being significant as predictors of variations in the survey context.

Overall, the findings on changes in IS use and factors involved provided insights into how change occurs via variation, selection and retention and the outcome of the change (i.e. deeper use). It is anticipated that the findings of this research will contribute to the post-adoption IS use literature and provide useful insights for managers as they tackle the problem of IS underutilization.

Acknowledgement

In 2012, I received a glass, a memorabilia of the Olympic Games. One year later, in my final year of study (2013), the glass broke. When it happened, I was quite upset, and as I took up the pieces to throw them away, the thought came to me 'Why not piece it together, and still have it as a keepsake'. This was an odd thought for me, as I was never one to do such. However, I got some tape and proceeded to get working on putting the pieces together. As I sat there taping up the pieces, a number of thoughts came to mind about the 'pieces' of my PhD journey.

First I remembered the major earthquakes (September 4, 2010 and February 22, 2011) that have affected the people of Christchurch, New Zealand along with the thousands of aftershocks. I arrived in Christchurch on August 28, 2010, so I was very much a part of the experience. I remembered the devastation, how buildings crumbled to pieces, how persons lost family and friends, but what stood out the most for me was how the people showed remarkable resilience in the face of earthquakes, the thousands of aftershocks, and the emergence of a new life and a changed city in 2012. I have garnered much strength from the people of Christchurch, and for that I am grateful.

During this journey I have been blessed with two wonderful supervisors Dr Annette M. Mills and Professor Wynne W. Chin whose guidance, insights, feedback and kindness have been very precious and invaluable in putting the pieces of my dissertation together. Their constructive criticisms and diligence in reading and commenting on the numerous drafts have improved the clarity and quality of the dissertation. Also, their patience, support and encouragement have been great, especially in the difficult dissertation days when Murphy's Law was en vogue. My supervisors not only played a role in shaping my dissertation, but also in my development as an academic, and in my personal growth. Dr. Annette Mills also provided invaluable help in my cultural and social adjustment to living in New Zealand, to which I am thankful for.

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Another important ‘piece’ of the PhD process was the support from my family. I would like to thank my family for their unyielding faith and encouragement throughout my journey. I would like to make special mention of my mother- Louisa Tennant- who has been my greatest ally. Thank you for supporting me during my studies and encouraging me; your constant love has been a tower of strength. The frequent calls, the packages from home with ‘treats’, your confidence and motivation have all helped me on my journey.

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All these pieces made the PhD process whole.

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Chapter 1. Introduction

1.1 Chapter Overview

"In much of society, research means to investigate something you do not know or understand."

[Neil Armstrong]

Throughout the past two decades, Information Technology (IT) has restructured the landscape of organizations (Lin & Shao, 2006). IT spending has increased in recent years (Lin & Shao, 2006), and it is expected that this trend will continue. For example, according to Gartner's latest forecast, it is anticipated that worldwide IT spending will reach $3.8 trillion in 2014, a 3.1 percent increase over spending in 2013, which was $3.7 trillion (Gartner, 2014). Specifically, enterprise software spending will continue to be strong in 2014, according to Gartner, which foresees the 2014 annual growth rate in that category rising by 6.8 percent (Gartner, 2014).

IT has played an increasingly significant role in organizations; however, the business value of IT investments continues to be a crucial but controversial issue. Closely related to the issue is the productivity paradox of IT, that is, whether IT contributes to organizational performance (Kohli & Devaraj, 2003; Macdonald, Anderson, & Kimbel, 2000; Melville, Kraemer, & Gurbaxani, 2004).

There is a trend in 'IT value measurement' that examines only hard, organizational-level measures of value, which may be a direct result of the amount of press that focuses on the IT productivity paradox (Chan, 2000). Nevertheless, much of the research literature underscores the importance of the human resource function (e.g., individuals), which uses business processes, in combination with technology, to achieve organizational goals (Chan, 2000). However, to gain returns on investment, how individuals use these systems are pivotal, as "technology per se can't increase or decrease the productivity of workers' performance", but instead "*only use of it can*" (Orlikowski, 2000, p. 425). Therefore, individuals' use of Information Systems (IS) is a driving force of long-term productivity and gain, and as such research into technology's impact must incorporate both technological artifacts and its use into its observations (Bostrom, Zackariasson, & Wilson, 2003).

In organizations, individual use of IS ranges from limited interactions (to the minimum extent possible) to leveraging more fully, the features of an IS to support work tasks (Loraas & Diaz, 2009). Even in mandatory settings, although individuals may have no choice in their use of the IS, it is often optional how they use, adopt, extend, expand and leverage their use of the IS for value enhancement (Jasperson, Carter, & Zmud, 2005; Loraas & Diaz, 2009).

What is most desirable is for users to proactively revise their IS use by applying best-suited features. But, too often users engage in surface-level use, minimising their interactions with the IS. There is therefore concern that IS underutilization by individuals (Jasperson, et al., 2005) is hindering efforts to exploit its benefits and infuse it into workplace practices. Thus given the significance of IS and its underutilization, it is paramount to understand the intricacies of post-adoption use, so as leverage the effective utilization of IS in organizations (Saeed & Abdinnour-Helm, 2008). One approach is examine how use of IS changes over time, as failure to do so may result in researchers and practitioners overlooking key insights into how users interact with the IS and the resulting outcomes (Orlikowski, 2000). It is therefore critical to understand the evolving nature of individuals' IS use behaviours in order to obtain a deeper understanding of IS use (Kim & Malhotra, 2005).

The current study assumes that IS 'use' as a behaviour can change, so the aim of this research is to provide a comprehensive yet parsimonious explanation of how post-adoption IS use changes over time. This research therefore investigates how individuals' use of IS changes over time. To understand how use changes, an evolutionary perspective on work routines is used, with the aim of this study being to investigate the process that underpins changes in IS use. Identifying (i) the key factors that trigger, enable, and inhibit change in use, and (ii) outcome of change (that is, other forms of use) are also key components of this study.

This chapter will discuss the research background, which highlights the relevance of a change focus in understanding post-adoption use and the theoretical lens used to examine change in this study. Subsequent sections outline the research questions, the research design, the research contributions and lastly structure of the dissertation.

1.2 Research Background

"The river is not an object but an ever-changing flow; the sun is not a thing, but a flaming fire. Everything in nature is a matter of process, of activity, of change" [Heraclitus of Ephesus c.475 BCE]

Change is a part of life; it is "a phenomenon of time. It is the way people talk about the event in which something appears to become, or turn into, something else, where the 'something else' is seen as a result or outcome" (Ford & Ford, 1994, p. 759). It is therefore likely that use of an IS will change over time, such that how an IS is used today may not be the same as how it was used in the past or may be used in the future. This section thus examines post-adoption use from a change focus, followed by the evolutionary framework that underpins this study, and then IS use in performing and/or supporting work routines.

1.2.1 Post-Adoption Use: Relevance of a Change Focus

Use of Information Systems is 'critically important' and is arguably the "most crucial variable in the repertoire of empirical and behavioural studies pinpointed at the intersection of computing and human beings" (Straub & del Guidice, 2012, p. ii). Research on innovation diffusion offers insights on the different stages of IS implementation, that is, pre-adoption and post-adoption of IS within organizations (Kwon & Zmud, 1987). The stages leading to the adoption decision can be referred to as pre-adoption stages, where the target behavior is adoption, while the stages following the adoption decision can be collectively referred to as post-adoption stages (Karahanna, Straub, & Chervany, 1999). The concept of system use has a long history in the IS field, however post-adoption behaviour (use) has received relatively little attention (Jasperson et al., 2005).

Post-adoptive behaviour can be defined as a myriad of feature adoption decisions, feature use behaviours, and feature extension behaviours made by an individual user after an IT application has been installed, made accessible to the user, and applied to accomplish ones' work activities (Jasperson et al., 2005). Evidence suggests that most users underutilize the 'functional potential' of IS in organizations, employing narrow feature breadths, operating at low levels of feature use and rarely extending their use of the available features (Jasperson et al., 2005). A resonating question is thus 'how can organizations leverage IS use among employees to actualize the benefits of IS?' Utilization is therefore not a simple 'yes' or 'no', as while users may not have the opportunity to choose the system they use (Lamb & Kling, 2003), there is some choice in the extent of use (Marler, Fisher, & Ke, 2009).

Post-adoption use of an IS varies from surface-level use to deeper levels of use that exhibit value-added engagement with the system (Agarwal, 2000). Deep use of an IS occurs when users make greater use of the features of an IS to support their work (Schwarz, 2003). While research into deep use behaviours, such as infusion, are instrumental in advancing our understanding, the emphasis has been on 'what factors' are important (Shaw & Jarvenpaa, 1997) as opposed to 'how they shape outcomes (Newman & Zhao, 2008).

Drawing from work on appropriation (DeSanctis & Poole, 1994) and enactment (Orlikowski, 1996), it is shown that there are continuous adjustments and improvisations in use, as users actively select how technology structures are applied. Both appropriation and adaptation construe selective changes in the use of IS (Barki, Titah, & Boffo, 2007), reaffirming that users are not 'passive takers' of technology, but active agents who shape their use of an IS (Sun & Zhang, 2006). Hence an infinite number and variety of use-oriented behaviours are likely as users selectively apply certain features and make modifications to how and for what purpose they use the system (Jasperson et al., 2005).

A change focus is therefore valuable as the features used by individuals change over time, and it is the particular features in use at any point in time that influence and determine various post-adoptive behaviours (i.e. use types) and work outcomes (Jasperson et al., 2005). Yet few studies have empirically examined change in use, even though research has found that feature selection varies over time (Al-Natour & Benbasat, 2009). Understanding change in use, that is, how individuals revise their use of the IS features, is paramount in advancing the post-adoption IS use agenda (Sun, 2012).

To better appreciate how changes in use come about, this study uses an 'evolutionary' perspective to understand and explain the changing nature of individuals' IS use as they perform work routines. The next section will discuss the evolutionary framework used that is, 'Generalized Darwinism', followed by how it can be applied within the context of IS use in enacting work routines.

1.2.2 Evolutionary Change: Generalized Darwinism

Evolutionary change entails a continuous cycle of variation, selection and retention among entities in a designated population (Van de Ven & Poole, 1995). Scholars have recognized the value of using evolutionary theory to guide their work in non-biological disciplines (Goetz & Shackelford, 2006), with the theory being used to describe many organizational changes (Burke, 2010). As such, principles of Darwinism have been used to study change in various domains at both the micro-level and macro-level (Aldrich, 1999; Breslin, 2011).

Geoffrey Hodgson and associates proposed a meta-theoretical framework, 'Generalized Darwinism', for describing and understanding change by applying a generalization of the basic Darwinian concepts of variation, selection and retention to the socio-economic domain (Aldrich & Ruef, 2006; Hodgson & Knudsen, 2006). Generalized Darwinism argues that Darwin's theory of evolution can be applied to all evolutionary processes, that is, the broad class of systems and populations of entities, including all feasible manifestations of development and change (Hodgson & Knudsen, 2006). With this in mind, Generalized Darwinists further argue that 'under some minimal conditions' on-going change in systems is inevitably Darwinian, as it must involve Darwinian principles of variation, selection, and retention (Aldrich et al., 2008; Hodgson, 2002; Hodgson & Knudsen, 2006).

Variation is an essential part of the change process, and is often dubbed the 'raw material' for evolution, since if there are no variations, then there are no alternatives to select from (Mayr, 1991). In a general sense, applied to non-biological domains, variation can be defined as any departure from routine or tradition (Aldrich, 1999, p. 22), or where individuals or groups generate a set of ideas on how to approach old problems in novel ways or to tackle relatively new challenges (Zollo & Winter, 2002) or generating new ways of doing things (Furneaux, Tywoniak, & Gudmundsson, 2010). *Selection* refers to forces that differentially select or selectively eliminate certain types of variations, while in *retention*, selected variations are then preserved, duplicated, or otherwise reproduced (Aldrich, 1999).

Generalized Darwinists argue that the Darwinian framework has a high degree of generality, as it provides a meta-theoretical structure of over-arching principles that can be used to frame and explain change (Hodgson & Knudsen, 2006). Although the abstract principles of variation, selection and retention do not themselves provide full or complete answers regarding change, they must be honoured, for the explanation of evolution to be adequate (Aldrich et al., 2008).

1.2.3 IS Use in Work Routines

All theories of change are concerned with change over time, hence, the basic notion of biological evolution is that species change over time. In applying Generalized Darwinism to this research, it is critical to discuss the fundamental element that actually evolves. This section will therefore discuss routines and how it relate to change in how an IS is used to support work routines.

It is widely accepted that routines is a collective-level phenomena rather than an individual-level phenomena (Nelson & Winter, 1982). Definitions of organizational routines involve multiple actors (or individuals) and emphasizes the interdependence of their actions (Felin & Foss, 2004). For example, an often cited definition refers to routines as 'repetitive, recognizable patterns of interdependent actions, carried out by multiple actors' (Feldman & Pentland, 2003). With regards to '*multiple actors',* Feldman and Pentland (2003) note that organizational routines entail the coordination of multiple organization participants, and are not simply individual routines performed in the context of an organization. Given that multiple individuals are involved, this introduces diversity in the information, interpretive schemes, and goals of the participants (Feldman & Pentland, 2003).

Definitions of routine also make mention of '*interdependent actions'*, hence like dancers, individuals must adjust to each other's actions, which suggests that individuals 'cannot just do as they please' (Feldman & Pentland, 2003). However, by the same token, due to the improvisatory nature of performing organizational routines (Pentland & Feldman, 2005), individuals do play a role in determining their actions and the extent to which they partake in various processes (Feldman & Pentland, 2003). The IS literature has highlighted the role of human agency in the use of IS as work tasks are enacted (Orlikowski, 1992, 1996; Orlikowski, 2000; Orlikowski & Baroudi, 1991). The inclusion of agency suggests that individuals are relatively free to enact technologies in different ways to accomplish organizational goals, as they improvise, innovate, and adjust their work routines over time (Orlikowski, 1996).

Understanding the role of individuals in routines resonates in the call for a micro-foundation outlook, which argues that routines (although a collective phenomenon) should be grounded in explanatory mechanisms that involve individuals' actions interactions, endowments, intentions, desires, expectations, goals and motivations (Felin & Foss, 2004). Hence individuals (in organizations) are more than just a 'cog in the wheel', but have a variety of a priori predispositions, experiences, characteristics and abilities (Felin & Foss, 2004).

Feldman and Pentland (2003) developed an 'influential theoretical account' of routines, proposing that it involves two elements: performative and ostensive aspect. *Performative* aspect is the actual enactment of the routine (Feldman & Pentland, 2003). Performances are the specific actions taken by the specific people at specific times when they are engaged in an organizational routine. (Feldman & Pentland, 2003). The *ostensive* aspect refers to the description or abstract pattern of the routine, and can be thought of it as a narrative or a script (Feldman & Pentland, 2003).

This research focuses on the '*performative*' element of the routine, that is, individuals' use of the IS, with an emphasis on their enactment in carrying out organizational routines. As succinctly stated by Feldman and Pentland (2003), without the performative aspect of the routine, nothing ever happens. Since performances enact the ostensive aspect of the routine, a focus on the performative aspect emphasizes the role of individual in 'creating and shaping' routines, and the importance of agency and subjectivity. Thus the agenda regarding a micro-foundation view of routines posits that it is essential to understand the micro entities that make up the 'collective', which includes the individuals, processes and interactions in the organizations (Felin, Foss, Heimeriks, & Madsen, 2012). An individual's use of an IS in performing their routines further underscores the role of human agency, as users can apply the IS minimally, invoke it individually or collaboratively, and improvise, innovate, and change their work routines over time (Orlikowski, 1996). How IS is used in routines is instrumental to the performative aspect, thus as use of the IS changes within a routine, so does the routine evolve.

Generalized Darwinism is used in this study to frame and understand how the performative aspects of routines change over time, that is, how routines are enacted through use of an IS and the changes that occur. In performing routines, it is the individuals' actions that is examined as they use the IS to accomplish organizational tasks. Individuals can select a particular routine for each task and subsequently enact the routine through use of the IS (Breslin, 2011). In the same way that the English grammar allows individuals to produce a variety of sentences (Pentland and Reuter 1994), an IS allows users to produce a variety of performances which individuals can select to construct sequences of behaviour to accomplish work goals. New variations can result in a range of different actions and/or behaviours in interaction with the IS, thus creating variations within and across individuals' post-adoptive behaviours (Jasperson et al, 2005). The actual variation at any time is a small portion of the contemplated variation, thus an important part of the selection process involves the winnowing of alternative ideas for action before final action is taken (Nelson, 2006) in how the IS is used. Retention, and thus change in use, occurs when the user incorporates a variation into how they perform their routines (Feldman & Pentland, 2003).

This study assumes that IS 'use' as an action may change over time, with such use being shaped and reshaped by elements such as change in user goals, environmental conditions, and the technology (Beaudry & Pinsonneault, 2005). Drawing on Generalized Darwinism as a framework of evolutionary change, this research examines change in how an IS is used to support one's work routines as well as the factors that trigger, enable and/or inhibit such change. The outcomes will include factors that influence change and provide suggestions for encouraging users through change, to leverage more fully the potentials of the IS to support their work.

1.3 Research Questions

"Research is formalized curiosity. It is poking and prying with a purpose" [Zora Neale Hurston]

This research seeks to investigate the following questions:

1. How does individuals' use of IS change over time?
    a) What behaviours (or actions) underpin individuals' change in IS use?
    b) What are the key factors that influence (i.e. trigger, enable, or inhibit) individuals to change the way in which they use an IS?
2. How does an individual's change in IS use lead to or impact other forms of use?

1.4 Research Design

“Design is not just what it looks like and feels like. Design is how it works” [Steve Jobs]

This research uses a sequential mixed method approach to examine change in use. Phase 1 is exploratory in nature and applies a qualitative mode of enquiry, while Phase 2 is confirmatory and uses a quantitative mode of enquiry.

Phase 1 uses case studies to investigate how use changes within a ‘real life’ context. This approach is particularly appropriate for research questions related to ‘why ‘and ‘how’ (Yin, 2002). Data was collected primarily through semi-structured interviews, observation and review of supporting materials (e.g. training and process documents) were also used to gather data for this study. Users of an IS often include basic, intermediate and advanced users. These categories of users tend to differ in the way they use the features of an IS (Munro, Huff, Marcolin, & Compeau, 1997). For example advanced users tend to have a more than an encyclopaedic grasp of the features and capabilities of the IS, and find new or unusual and especially effective ways of using the IS, while basic users tend to use a narrow set of IS features in performing work tasks (Munro et al., 1997). To ensure a cross-section of user participants (i.e. basic, intermediate and advanced users) with opportunities to ‘vary’ their use of an IS, different types of users were interviewed. Definitions for each user category were adapted from Munro et al. (1997) and provided to each organizational representative to identify participants within the organization. Organizations with Complex IS (e.g. ERP, CRM systems) were targeted in this study as these afford greater opportunities for use to vary. Thus, purposeful sampling was used to select the focal system and the participants that were interviewed.

For the user interviews, the Critical Incident Technique (CIT) was used to guide the data collection as it facilitates the investigation of significant occurrences (e.g. events, incidents, or processes) identified by the respondent, the way they are managed, and the outcomes (Flanagan, 1954). As respondents related their ‘journey’ of how their use had changed (or not) over time, they were asked to relate incidents or events that describe instances of change. Probing questions were then asked to understand the ‘how’ and ‘why’ of such changes. Interviews were audio-recorded and fully transcribed. Data analysis included exploration of the data by reading through the transcripts, coding the data by segmenting and labelling the text and extracting key themes, then connecting the themes (Miles & Huberman, 1994).

For Phase 2, findings from the case studies together with key theories were used to frame the research model for further analysis. In many cases, previously validated scales were adapted to measure key variables, while some measures were self-developed (such as those for variation and retention) where no suitable or prior measures were found. The model was then tested using data from a field survey and analysed using the PLS approach to path modelling to gain further insights on the impacts of the various determinants on change in use.

1.5 Research Contributions

"*When you cease to make a contribution, you begin to die*" [Eleanor Roosevelt]

As organisations continue to invest heavily in IS to support business processes, underutilization remains a key concern that challenges efforts to exploit its benefits. This research makes a number of theoretical and practical contributions to the IS literature.

From a theoretical perspective, there is a short supply of research on post-adoption IS use, particularly on how individuals choose to or are influenced to learn about, selectively adopt and apply, and then extend IS use (Jasperson et al, 2005). While prior models such as Technology Acceptance Model and Task Technology Fit provide insights on the use of an IS, they do not explain how and why users revise their use of an IS as they enact work tasks (Beaudry and Pinsonneault, 2005).

While there are a few studies on change in IS use (Al-Natour & Benbasat, 2009), these are limited in their focus and ability to explain change at the individual level and its outcomes (Fadel, 2012; Sun, 2012), with the emphasis being on 'what factors' are important as opposed to 'how' they shape outcomes (Shaw & Jarvenpaa, 1997). For example, while Sun (2012) offers a theoretical framework of the types of changes that occur and the triggers leading to such change to explain how and why persons revise their system use, this study does not elaborate the change process in terms of how it unfolds. Further, it does not offer a predictive model of change in terms of understanding the outcome of change. Likewise, Orlikowski (2000) also examines how changes in use have been enacted over time, but do not attempt to predict change nor do they examine the outcomes of such change. This research therefore seeks to bridge a gap in the literature by investigating further, the process of change and seeking to identify the conditions under which change can occur and the outcome of such change. This study therefore contributes to the literature by going a step further than prior research (Orlikowski, 2000; Sun, 2012) and offers a predictive model of change to advance our understanding of change.

In so doing, this study responds to calls for greater attention to understanding change in IS use (Fadel, 2012; Jasperson et al., 2005; Orlikowski, 2000; Sun, 2012), in particular how and why users change their use of an IS over time, the process that underpins change, and the outcomes of such change. Thus, a key theoretical and empirical contribution of this research is that it puts forward and assesses a new lens, that is, Generalized Darwinism, for examining change in IS use over time. This research applies this evolutionary lens at the micro-level, focusing on the performative routine, that is, individuals' use of an IS in carrying out organizational routines.

Thus, theoretically, this research responds to calls for (i) alternative theoretical perspectives to better understand variation within and across individuals' post-adoptive behavior (Jasperson et al., 2005), and (ii) a micro-foundation view of routines, that is, understanding the micro entities that make up the 'collective', which includes the individuals, in the organizations (Felin et al., 2012).

Further, there were no prior studies found that have systematically developed and empirically tested measures for variation and retention either within or outside the IS literature. Thus, beyond a theoretical contribution on change in IS use, this study also provides a set of adaptable measures for assessing the concepts of variation and retention which can be used to operationalize the constructs in future models aimed at assessing and predicting change.

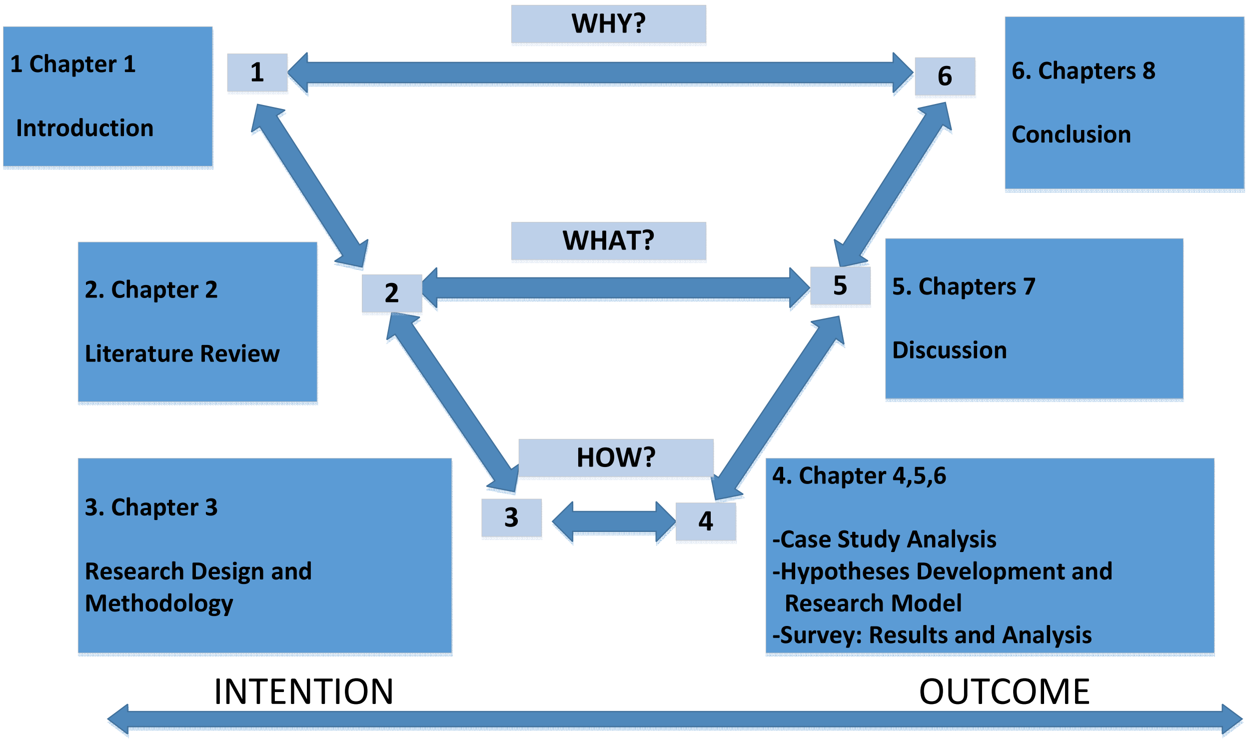
From a practical perspective, using the words of Davenport, Harris, & Cantrell (2004, p. 25), *"for those executives who feel their organizations have yet to realize the promise of ESs [Enterprise Systems] the answer is clear: do not give up yet."* The findings will shed light on opportunities for organizations to foster appropriate changes in IS use by understanding the rationale behind users' actions and thus implement strategies that encourage users to explore, adapt and extend their use of pertinent features of the system.

1.6 Structure of the Dissertation

"All you need is the plan, the road map, and the courage to press on to your destination"
[Earl Nightingale]

The overall structure of the dissertation was developed using the V Model as its framework (Sheffield, 2005), which is a graphical display technique that presents levels of abstraction (vertical axis) against time (horizontal axis). Key dependencies and relationships between each of the thesis chapters are shown both vertically and horizontally in Figure 1.1. The top level of the V Model (steps 1 and 6) represents the highest level of abstraction, that is, the overview and conclusion. The base points (steps 3 and 4) represent the lowest level of abstraction, specifically the research methodology, data collection and analysis, that supports the higher level discussion (Sheffield, 2005). Of particular importance is the horizontal link between steps 1 and 6, where the initial intentions of the research outlined in Chapter 1 is matched against the final outcomes described in Chapters 8.

Figure 1.1 The V-Model -Structure of Dissertation



Chapter 1 – *Introduction,* provides an overview of the dissertation, giving an outline of the premise behind and motivation for this research. It describes the background to the research, defines the research area, the context in which it is placed, and the key issues being explored. It also identifies the value that undertaking such a research expects to deliver to both theory and practice.

Chapter 2 – *Literature Review,* describes the specific objectives of this study. It also explores research literature on change, and more specifically evolutionary change. Providing a background to evolution, it explores the biology literature to provide a greater understanding of the evolution context. It then describes Generalized Darwinism framework (the lens used in this research), which argues that Darwin's principles of evolution - variation, selection and retention - can be applied in an abstract manner to understand change within a system. It therefore discusses the triumvirate of *variation*, *selection* and *retention* within the Generalized Darwinism framework. In using the evolution framework, a key question that should be answered is 'what actually evolves', and as such, the literature review introduces the concept of routines and how it relates to IS use, also describing it within the context of Darwin's principles.

Chapter 3 – *Research Design and Methodology,* details the philosophical assumptions underpinning the research. It explains and justifies the mixed method approach (qualitative phase followed by a quantitative phase), and discusses the methodology, data collection and analysis techniques used in each phase.

Chapter 4 – *Case Study Analysis,* describes the three (3) organizations used for this research, and the 39 users who were the units of analysis. It reports on the results from the cases using the Generalized Framework by applying the principles of variation, selection and retention to explain change in use.

Chapter 5 – *Hypotheses Development and Research Model,* presents a research model and hypotheses developed based on the findings from the case studies and identified prior research in the literature.

Chapter 6 – *Survey: Results and Analysis,* details the methodological approach used for the quantitative phase and also reports on the tests of the model and its hypotheses outlined in Chapter 5. The first section outlines the methodology and instrument design process, specifically the pre-test, field study, measurement items, survey design, questionnaire format and administration. The second section focuses on the analysis of the findings from the survey. It will report on the results of both the measurement and structural model tests using PLS Graph.

Chapter 7 – *Discussion*, discusses the results, incorporating findings from both the qualitative and quantitative phase.

Chapter 8 – *Conclusion,* provides a summary, as well as the contributions of this research to both theory and practice. This chapter also acknowledges the limitations and offers a set of recommendations for future research.

1.7 Chapter Reflection

Without reflection, we go blindly on our way, creating more unintended consequences, and failing to achieve anything useful" [Margaret J. Wheatley]

The aim of this research is to provide a comprehensive yet parsimonious explanation of post-adoption IS use in organizations. This chapter introduced the importance and motivation of the research. It then briefly described the background to the research and the theoretical lens. The aims of the study and the research questions were then presented followed by an overview of the methodology, then the theoretical and practical contributions of this research. Finally, the structure of this thesis was outlined with a brief description of each chapter. The following chapter (Chapter 2) reviews the existing literature in order to develop a clear understanding of IS post-adoption use, and how evolutionary theory is applied in this research.

Chapter 2. Literature Review

Lord Polonius: What do you read, my lord?
Hamlet: Words, words, words.
Lord Polonius: What is the matter, my lord?
Hamlet: Between who?
Lord Polonius: I mean, the matter that you read, my lord."
[William Shakespeare, Hamlet]

2.1 Chapter Overview

This chapter defines the specific objectives of the research, and provides a general discussion of the literature on Information System (IS) use and change. It is divided into separate sections, each one defining the research problem and approach further. Therefore it develops an initial structure and context for this research that assists the methodological approach outlined in Chapter 3, the analysis of the case studies in Chapter 4 and the survey findings in Chapter 6. There was a deliberate intention, influenced by the principles of inductive research, to bring as little as possible in the way of predetermined views (e.g. factors) either experiential or from literature, into this research. Thus, much of the hypotheses development that would typically be included in a traditional literature review is revisited in Chapter 5 (Hypotheses Development and Research Model).

Consequently, the literature reviewed and discussed in this chapter relates primarily to post-adoption IS use, and the gaps identified in the extant literature that shaped the motivation and research questions for this study. Another significant aspect of the literature review is the concept of change, in particular, evolutionary change. The literature review discusses the concept of routines, within evolution, and how it applies within the context of this research. The evolutionary framework oriented the researcher towards inclusion and openness to discovering what aspects to focus on rather than, to some extent, establishing limits and exclusions on what to collect. As Patton (1990, p. 218) points out, a researcher "does not enter the field with a completely blank slate", and thus "some way of organizing the complexity of the reality is necessary." Accordingly, he suggests that the theory provides a "basic framework highlighting the importance of certain kinds of events, activities and behaviours"(Patton, 1990, p. 216). In the case of this research, the evolutionary framework, specifically, Generalized Darwinism serves as a lens to investigate and explain change in IS use over time.

2.2. Innovation Diffusion

Innovation Diffusion research provides a valuable perspective for observing themes and frameworks on Information Technology (IT) evaluation, adoption and implementation (Fichman, 1992) and by extension the adoption, diffusion and infusion of IT into organizational life (Chin & Marcolin, 2001). Research on innovation diffusion offers insights on the different stages, that is, pre-adoption and post-adoption of IS within organizations (Kwon & Zmud, 1987). The stages leading to the adoption decision can be referred to as pre-adoption stages, where the target behavior is adoption, while the stages following the adoption decision can be collectively referred to as post-adoption stages (Karahanna et al., 1999).

There exists several models that relate specifically to the process of innovation in organizations, for example, those posited by researchers such as Pierce and Delbecq (1977), Kimberly (1981), Rogers (2003), Kwon and Zmud (1987) and Cooper and Zmud (1990), whose studies are complementary. Using the categories proposed by Cunha and Verhallen (1998), the innovation models can be grouped into three (3) main stages: (1) *Initial Phase*: The innovation is recognised and appreciated by the organization, (2) *Intermediate phase(s)*: Transformation of the innovation into the organization's workflow and (3) *Final Phase*: The last stage of the innovation process representing the culmination of the innovation activities. Using this grouping, Table 2.1 was drafted to depict the distribution of the phases/activities in selected innovation models across the three (3) stages. The next set of paragraphs will discuss these models, with emphasis on the post-adoption stage.

Table 2.1 Phases of Organizational Innovation Models

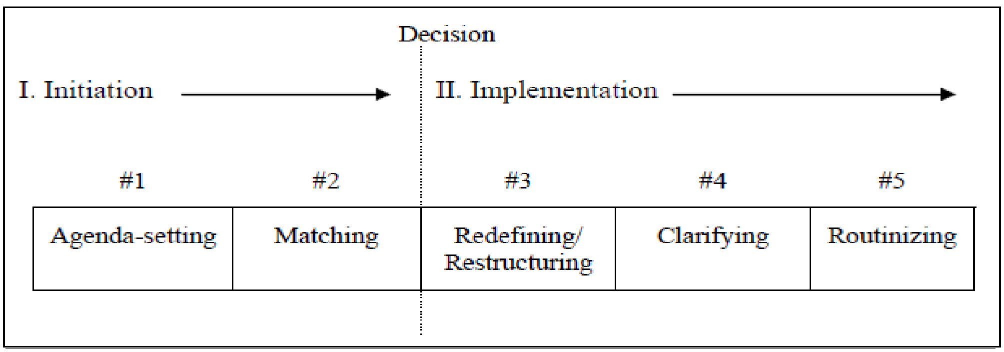
	Initiation	Intermediate Phase(s)	Final Phase
Pierce & Delbecg (1977)	Initiation→	Adoption→	Implementation
Kimberly (1981)	Adoption→	Utilization→	Exnovation
Kwon& Zmud (1987)	Initiation→	Adoption→Adaptation→Acceptance→Use	Incorporation
Rogers (2003)	Agenda-Setting → Matching→	Redefining→Clarifying→	Routinizing
Cooper & Zmud (1990)	Initiation→	Adoption→Adaptation→Acceptance→ Routinization→	Infusion

Early models by researchers such as Pierce and Delbecq (1977) proposed three (3) stages of organization innovation: *Initiation*, *Adoption* and *Implementation*. A criticism of these earlier generic models is that they assume the innovation is ‘inherently good’ (Kwon & Zmud, 1987), resulting in a pro-innovation bias (Rogers, 2003). Another critique raised by Kwon & Zmud (1987) is that these early models tend to exclude any post-adoption or post-innovation processes.

Later innovation diffusion models addressed some of these concerns. For example, Kimberly (1981) proposed three (3) stages: (i) *Adoption*, (ii) *Utilization* and (iii) *Exnovation/Removal* of the innovation from the organization (Cunha & Verhallen, 1998). Later, Rogers (1995, 2003) categorized the innovation process into two main stages: *initiation* and *implementation* (See Figure 2.1). These were further broken down into five sub-stages, with the *initiation* stage including: (1) *Agenda-Setting*, and (2) *Matching*; and the implementation stage, including (3) *Redefining/Restructuring*, (4) *Clarifying* and (5) *Routinizing.*

In the *initiation* stage, the organization’s problem is defined and the need for the innovation is identified (Agenda-Setting). Then, the fit and feasibility of the innovation is explored in relation to the organization’s problem (Matching). In the *implementation* stage, the technology is altered to accommodate the organization’s need and structure (Redefining/Restructuring), followed by clarifying where the innovation is explained to organizational members to promote widespread use. It is therefore in the final stage, ‘routinizing’, that the innovation is incorporated into the regular activities of the organization and has lost its separate identity (Rogers, 2003).

Figure 2.1 Roger's Five Stages in the Innovation Process

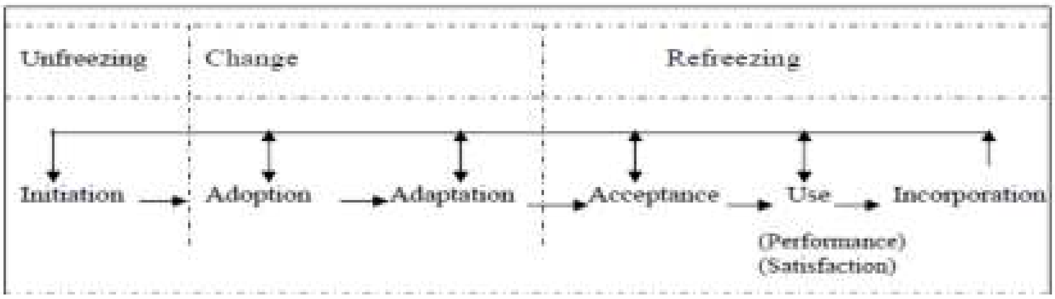


Source: Rogers (2003)

Although Roger's model is succinct, it is incomplete and has significant room for improvement, as it lacks details on understanding how to maximize the potential for successful implementation (Dewett, Whittier, & Williams, 2007). Based on this critique, one could argue that the model proposed by Kwon and Zmud (1987) and Cooper and Zmud (1990) is more complete than Roger's model.

Kwon and Zmud (1997) argue that many models tend to place greater emphasis on adoption, and therefore tend to overlook what happens after adoption, that is, post-adoption. To address this gap, Kwon and Zmud (1987) proposed a six (6) phase implementation process (linked to Lewin's (1952) change model), which includes: *initiation*, *adoption*, *adaptation*, *acceptance*, *use* and *incorporation* (See Figure 2.2). Initiation defines the 'Unfreezing' stage, when change is initiated; Adoption and adaptation enables the 'Change' stage, while the acceptance, use and incorporation are in the 'Refreezing' stage when the change is incorporated into one's routine. Kwon and Zmud (1987) also dubbed incorporation as the final 'implementation' process, which is where the innovation becomes embedded within an organization's routine and is applied to its full potential within an organization.

Figure 2.2 A Six-Phase view of the IS Implementation Process



Source: Kwon and Zmud (1987)

Cooper and Zmud's (1990) implementation model, a variation of that by Kwon & Zmud (1987) also has 6 stages: *initiation*, *adoption*, *adaptation*, *acceptance*, *routinization* and *infusion* (See Table 2.2). Similar to Kwon and Zmud (1987), Cooper and Zmud (1990) also associate the phases of implementation with Lewin's change stage: Unfreezing (Initiation); Change (Adoption and Adaptation); Refreezing (acceptance, routinization and infusion). They caution however that the stages are not necessarily sequential, and may occur in parallel. There is some overlap between the 'infusion' and the 'incorporation' stage in Kwon and Zmud's (1987) and Cooper and Zmud's (1990) model, as they both encompass comprehensive use, which is, use to its fullest potential. A unique contribution of Cooper and Zmud's (1990) model is the categorization of each stage in terms of 'product' and 'process', as outlined in Table 2.2.

Table 2.2 Stages of the IT Innovation Process

Stage	Definition as a 'Product'	Definition as a 'Process'
Initiation	Active and/or passive scanning of organizational problems/opportunities and IT solutions are undertaken.	A match is found between an IT solution and its application in the organization
Adoption	Rational and political negotiations ensue to get organizational backing for implementation of the IT application,	A decision is reached to invest resources necessary to accommodate the implementation effort
Adaptation	The IT application is developed, installed and maintained. Organizational members are trained both in the new procedures and in the IT application.	The IT application is available for use in the organization.
Acceptance	Organizational members are induced in to commit to IT application usage	The IT application is employed in organizational work
Routinization	Usage of the IT application is encouraged as a normal activity	The organization's governance system are adjusted to account for the IT application; the IT application is no longer perceived as something out of the ordinary
Infusion	Increased organizational effectiveness is obtained by using the IT application in a more comprehensive and integrated manner to support higher level aspects of organizational work	The IT application is used within an organization to its fullest adoption.

Source: Adapted from Cooper and Zmud (1990)

2.3 Post-Adoption

The processes/stages in the innovation models differ with regards to the terms and definition; however, there are two common themes that emerge: *adoption* and *post-adoption* (e.g. acceptance, routinization and infusion).

This research focuses on post-adoption use, particularly *post-adoptive behaviours*, which can be defined as a myriad of feature adoption decisions, feature use behaviours, and feature extension behaviours made by an individual user after an IT application has been installed, made accessible to the user, and applied by the user in accomplishing his/her work activities (Jasperson et al., 2005). Simply put, post-adoption explores the usage behaviour of individuals, and the manner in which they make use of the IS features after it is available for use to support their work.

In organizations, individuals' use of IS is a driving force of long-term productivity and gain (Jain & Kanungo, 2005). In mandatory settings, for example, although individuals have no choice in their use of the IS, it is more or less optional as to how they use and/or leverage the IS features (Jasperson et al., 2005; Loraas & Diaz, 2009). What is most desirable is for users to proactively revise their IS use by applying best-suited features. But, too often users engage in surface-level use, minimising their interactions with the IS. There is therefore concern that IS underutilization by individuals (Jasperson, et al., 2005) is hindering efforts to exploit its benefits and infuse it into workplace practices.

Understanding the concept of IS usage at the post-adoption stage can provide insights that may be instrumental in leveraging the effective utilization of IS (Saeed & Abdinnour-Helm, 2008). However, research in this domain, although progressing has been lacking (Dewett et al., 2007; Kimberly, 1981; Kwon & Zmud, 1987), with much of the IS literature primarily focusing on initial stages of adoption as opposed to post-adoption (Eder & Igbaria, 2001; Zhu & Kraemer, 2005). In recent times, however, research in post-adoption has received more attention, which Ortiz de Guinea and Markus (2009, p. 433) describes as "one of the most welcome developments in recent Information Systems scholarship." Nevertheless, despite more than 20 years of research on IT adoption and use, our collective understanding of post-adoption use behaviours is still at an early stage of development (Jasperson et al., 2005).

In the post-adoption stage, users can actively choose to explore, adopt, use, and possibly extend one or more of the application's features (Jasperson et al., 2005). As a result, failure to examine what actually happens in individuals' use of an IS may result in researchers and practitioners overlooking key insights into how users interact with the IS and the resulting outcomes (Orlikowski, 2000). To obtain a deeper understanding of continued and deeper use of IS, it is critical to understand the evolving nature of individuals' IS use as they apply the system to carry out their work tasks (Kim & Malhotra, 2005).

2.3.1 Enablers, Triggers and Inhibitors

Evidence suggests that most users underutilize the 'functional potential' of IS in organizations, employing narrow feature breadths, operating at low levels of feature use and rarely extending their use of the available features (Jasperson et al., 2005). Given that IS are often underutilized, it is important to understand post-adoption use of an IS and how it changes over time so as to leverage more effective use of IS resources (Saeed & Abdinnour-Helm, 2008). Although research into effective uses of IS is advancing, there is a need to focus on more 'complex and deep' uses of IS features (Chin & Marcolin, 2001) specifically how such uses come about. The idea of deep use of an IS has been defined as the extent or variety of use of different functionalities of an IS (Schwarz, 2003). Also, there have been calls for further work on factors that trigger, enable, and/or inhibit deeper uses of IS (Cenfetelli & Schwarz, 2011; Jasperson et al., 2005; Jones, Sundaram, & Chin, 2002). To understand how use can change over time, this section will therefore discuss the extant literature on triggers, enablers and inhibitors of deeper use of IS.

2.3.1.1 Enablers

Traditionally, the theoretical foundation for antecedents in post-adoption IS use include (but is not limited to) Technology Acceptance Model (TAM), Theory of Reasoned Action (TRA), IS Continuance Model (ISC), Symbolic Adoption Theory, Psychological Empowerment Theory and Self-Efficacy Theory (Hsieh & Wang, 2007; Jones et al., 2002; Mills & Chin, 2007; Ng & Kim, 2009; Wang & Butler, 2007; Wang & Hsieh, 2006). In such models, the categories for the antecedents include *user/individual characteristics* (e.g. attitude, personal innovativeness, satisfaction, user competence, self-determination, symbolic adoption, self-efficacy) (Hsieh & Wang, 2007; Jones et al., 2002; Mills & Chin, 2007; Ng & Kim, 2009; Wang & Hsieh, 2006), *perceptions of the system* (e.g. perceived usefulness, perceived ease of use, compatibility, usage impact, satisfaction) (Hsieh & Wang, 2007; Jones et al., 2002; Mills & Chin, 2007; Ng & Kim, 2009; Wang & Butler, 2007); *control factors* (e.g. facilitating conditions) (Jones et al., 2002), *level of implementation/use* (e.g. routinization) (Sundaram, Schwarz, Jones, & Chin, 2007).

Theories such as TAM and TRA, although integral in explaining intention or regular use, are lacking in explaining actual use and/or deeper types of use, such as infusion (Jones et al., 2002), and are insufficient in addressing use that increases productivity (Grgecic & Rosenkranz, 2010). Hence, caution should be taken when applying such theories to deep-use types (Hsieh and Wang, 2007) and there is a need for further work on factors that are better suited in the post-adoption context and that enable movement towards deeper use (Chin & Marcolin, 2001; Hsieh & Wang, 2007).

For example, one of the shortcomings is that use behaviours are generally modelled (whether implicitly or explicitly) as influenced by similar factors to those used in acceptance and initial use studies (Jasperson et al., 2005). However, it has been argued that political and learning models may be better suited to explain post-adoptive behaviours, while adoption may be better explained by task-technology fit (Cooper & Zmud, 1990; Jasperson et al., 2005).

For instance, perceived usefulness as a factor has received mixed results (Hsieh & Wang, 2007; Jones et al., 2002; Ng & Kim, 2009; Wang & Hsieh, 2006). A possible explanation is that perceived usefulness is a less appropriate motivator for deep uses such as infusion, as users have already experienced the technology and hence have confirmed the expected benefits (Ng and Kim, 2009). Ng and Kim (2009) posit that the weak and inconclusive results are possibly a consequence of the employment of rational-oriented predictors and models that are less appropriate for deep uses, such as infusion.

Consequently, it appears that factors not adequately explored in previous research may influence post-adoption use (Jasperson et al., 2005). Researchers have therefore made calls for further work on advancing the understanding of factors enabling post-adoption use, such as individual characteristics and differences such as experience, expertise, attitude towards each potential use of the system, self-efficacy, and locus of control (Beaudry & Pinsonneault, 1999; Hsieh & Wang, 2007; Sundaram et al., 2007), organizational, managerial and social factors (Hsieh & Wang, 2007; Wang & Hsieh, 2006), task and outcome interdependences (Hsieh & Wang, 2007) and motivation (Ke, Tan, Sia, & Wei, 2013; Peijian & Lihua, 2007).

2.3.1.2 Triggers

Triggers can be defined as circumstances or events, which bring about changes, for example through learning (Mezirow, 1990; Zhang, Macpherson, & Jones, 2006) or sense making (Louis & Sutton, 1991; Weick, 1995).

Triggers can be internal or external. Internal triggers are events that occur within the group or by an individual, when goals are not met effectively (Annabi, 2007). For example, this could be due to lack of resources to perform tasks or an error or mismatch of expectations (Annabi, 2007). On the other hand, external triggers are events that happen in the environment that requires an individual to change their behaviour to meet desired goal(s) and/or perform its function (Annabi, 2007). External triggers, for example, could come in the form of new technologies or external expectations, such as new regulations (Annabi, 2007).

Triggers in post-adoption IS use remains under-researched, but has recently gained more attention from IS researchers (Jasperson et al., 2005; Ortiz de Guinea & Markus, 2009; Sun, 2012). For example, Sun (2012) applied Louis and Sutton's (1991) theory to IS post-adoption to examine triggers of 'adaptive system use' (that is, users' revision in their use of IS features). Sun (2012) found that novel situations (e.g. new tasks, others' use, and changes in the system environment) and discrepancies (e.g. the outcome of using a system is different from what was expected) were significant. However, deliberate initiative (e.g. a user is asked by his or her boss to use system features with which he or she is not familiar) was not significant as a trigger of change.

In order to further increase the understanding of how and why individuals actively revise their use of an IS, it is important to investigate triggers in IS use (Jasperson et al., 2005). A greater understanding of triggers can serve as an impetus to change, and the findings can be used by IS practitioners to encourage (or constrain) changes in IS use (Sun, 2012).

2.3.1.3 Inhibitors

There is scant research on inhibiting factors in the IS use domain (Cenfetelli & Schwarz, 2011), and there is an implicit assumption that the inhibitors of use are the opposite of the facilitators (Cenfetelli, 2004). However, research in psychology and organizational literature has argued that 'bad is stronger than good' (Baumeister, Bratslavsky, Finkenauer, & Vohs, 2001; Rozin & Royzman, 2001). Based on the principle of negative potency, it is posited that given "inverse negative and positive events of equal objective magnitude, the negative event is subjectively more potent and of higher salience than its positive counterpart" (Rozin & Royzman, 2001, p. 298). As a result, it is not necessarily accurate to assume that the effect of a negative element is the reverse of a positive element (Choi, Anderson, & Veillette, 2009). Another argument is that "the negativity of negative events grows more rapidly with approach to them in space or time than does the positivity of positive events" (Rozin & Royzman, 2001, p. 298). Hence, negative factors can have strong adverse effects on one's actions over time.

IS research has found that the presence of an inhibiting factor is likely to have an adverse effect on use. Examples of inhibitors investigated include lack of knowledge (Venkatesh & Brown, 2001), lack of IT support (Chau, 2001), user resistance (Beaudry & Pinsonneault, 2005), job overload (Ahuja & Thatcher, 2005), information inhibitors (e.g. information overload, deceptiveness) (Cenfetelli & Schwarz, 2011) and system inhibitors (e.g. intrusiveness, effort redundancy, process uncertainty)

(Cenfetelli & Schwarz, 2011). As put by Cenfetelli and Schwarz (2011, p. 808), "inhibitors are more than just the antipoles of enablers" and as such "are distinct constructs worthy of their own investigation." In essence, solely focusing on enablers excludes other relevant factors in use (Cenfetelli & Schwarz, 2011), thus inhibitors are also considered in this study.

In closing, this dissertation seeks to address the lacunae in post-adoption IS use literature by investigating and understanding the nature of IS use behaviour as it changes over time. As an initial step, it is important to understand the factors that trigger, enable and/or inhibit change in use. The next section of the literature review will provide further insights from scholars that justify the relevance of a change focus in post-adoption IS use.

2.4 Changes in Post-Adoption Use

What does *change* mean? An English dictionary definition of 'change' (as a verb) is *"to make or become different' or 'to take or use another instead of"* and (as a noun) *"an act or process through which something becomes different"* (The Oxford Dictionary).

Change is a part of life; it is a phenomenon of time, the way individuals talk about an event in which something appears to become, or turn into, something else, where the 'something else' is seen as a result or outcome (Singletary, Akbulut, & Houston, 2002). From a philosophical stance, based on Aristotelian principles, change involves an object that persists and retains its identity through time, while having (or lacking) a certain property at one time and lacking (or having) that property at a later time (Hussey, 1999). Van de Ven and Poole (1995) therefore posit change as an observation of difference in an entity's (e.g. individual's job, strategy, routine, etc.) form over time.

This research applies the definition put forward by Van de Ven and Poole (1995), defining change in the context of this research, as an '*observation of difference in an individual's use of an IS over time*.' This research assumes that it is likely that use will change over time such that how an IS is used today may not be the same as how it was used in the past or may be used in the future. Since, it is justifiable to assume that 'use' is something that changes, there is a need to further understand 'how', 'why' and under what circumstances this occurs especially at the individual level in organizations (Sun, 2012). For this research, it should be noted that the emphasis is not on the internal dynamics of use, nor a comparison of two measurements before and after, but rather on change, along with identifying, describing and explaining the elements that bring about change in individuals' use of the IS.

Drawing from work on appropriation (DeSanctis & Poole, 1994) and enactment (Orlikowski, 1996), there are continuous adjustments and improvisations in use, as users actively select how 'technology' structures (i.e. the features) are applied. Both appropriation and adaptation construe selective changes in the use of IS (Barki et al., 2007), reaffirming that users are not just ‘passive takers’ of technology (Desouza, Awazu, & Ramaprasad, 2007), but instead active agents that shape their use of the IS (Sun & Zhang, 2006). Hence an infinite number and variety of use-oriented behaviours are likely as users selectively apply certain features, and make modifications to how and for what purpose they use the system (Jasperson et al., 2005). With post-adoptive cycles of adaptation, it is evident that users will revise how they apply IS features in their context to support their work (Sun, 2012).

There are diverse ways in which an IS can be appropriated and applied by users, thus forms of use can vary over time (Orlikowski, 1992). For instance, Orlikowski (2000) described how users enacted technologies over time based on evidence from a case study. She found that individuals can use the technology to retain their existing way of doing things, thus using the IS in limited ways. This is evident as individuals use the IS rarely and perfunctorily, showing little or no interest in incorporating its use into their on-going work practices. Alternatively, individuals may use the IS to augment or refine their existing ways of doing things. Finally, users can ‘change’ their use of the system as they substantially alter their existing ways of doing things, by for example, experimenting with and implementing new ways of working and organization and thus adapting features of the IS.

However, post-adoptive behaviours not only intensify use, they can also diminish use over time, as various features of the IS are resisted, treated with indifference, or used in a limited fashion (Jasperson et al., 2005). Patterns of post-adoption use therefore reflect in essence a collection of IS application features that an individual has adopted, used, dropped, and extended over time (Jasperson et al., 2005).

The concept of change is central to the problem of underutilization, as in order to extract the benefits of an IS, it requires some degree of change on the users’ part as they modify how the IS in incorporated into work practices (Orlikowski, 2000; Sun, 2012). Furthermore, a change focus, coupled with examination at the feature level, is valuable as the features used by individuals change over time, and it is the “specific features in use at any point in time that influence and determine work outcomes” (Jasperson et al., 2005, p. 529).

There is therefore a greater need for researchers to investigate how individuals selectively adopt, apply, exploit and extend the feature sets of an IS that is introduced to enable and/or support organizational work systems (Desouza et al., 2007; Jasperson et al., 2005). Yet few studies have empirically examined change in use, even though research has found that IS use through feature selection varies over time (Al-Natour & Benbasat, 2009). Furthermore, there is a limited understanding of how users interact with IS in the post-adoption stage (Desouza et al., 2007).

To obtain a greater understanding of continued and deeper use of IS, it is critical to understand the evolving nature of individuals' IS use (Kim & Malhotra, 2005). Understanding change in use, that is, how individuals revise their use of the IS features, is paramount in advancing the post-adoption agenda (Sun, 2012). As Orlikowski (2000) articulated, "recognizing that the possibility to change technology structures is inherent in every use of technology allows us to understand when, where, how and why people choose to reinforce, ignore, enhance, undermine, change, work around or replace their existing structures of technology use" (p. 424). Consequently, examining changes in individuals' post-adoptive behaviour over time can provide insights into why and how patterns of feature use evolve, and thus extract differential value from the IS. This dissertation posits that a change focus will not only deepen our understanding of how change occurs, that is, the various ways in which individuals change their use, but also shed light on the factors that influence such changes in use.

The next section examines evolutionary change, which serves as the meta-theory that underpins this research on change in IS use.

2.5 Evolutionary Change

The previous section emphasizes the importance of understanding individuals' changes in IS use. Understanding the factors and dynamics that influence these behaviours is central to the introduction of interventions that facilitate effective use of IS features that enable or support work tasks and processes (Jasperson et al., 2005). In a seminal and highly cited paper that reviewed the IS post-adoption literature, Jasperson et al (2005) urged researchers to "develop and apply richer and more complex research models in examining the variation within and across individuals' post-adoptive behavior" (p. 534). This dissertation applies a theory of change to understand post-adoptive behaviours over time.

There are at least four perspectives that can be used to analyse change processes: lifecycle, teleological, dialectical and evolutionary (Van de Ven and Poole, 1995). This dissertation seeks to understand changes in IS use, by drawing on theories of *evolutionary change* (Van de Ven & Poole, 1995), in particular '*Generalized Darwinism*' (Hodgson, 2005; Hodgson & Knudsen, 2006) to frame this research, which will thus form the main discussion in the body of the dissertation. Since it is not possible to examine and validate each of these theoretical perspectives in this dissertation per se, Appendix A provides a summary of the other three (3) change processes.

The term ‘evolutionary’ can be defined as a class of theories or models or arguments that seek to explain the movement of something over time, or to explain why that something is what it is at a moment in time, in terms of how it got there (Dosi & Nelson, 1994). In the context of this research, this study seeks to explain change in IS use over time, and to explain the factors that may influence change, and the results and/or outcome of change.

Since the concept of evolutionary change is central to this study, it is important to understand key aspects encompassing ‘evolution’. As a result, the next section reviews the underpinnings of evolutionary theory starting with its foundation in biological evolution, on which the concept of Generalized Darwinism is built.

2.6 Biological Evolution

The biologist, Albrecht von Haller was the first to use the term ‘evolution’ in 1744 to describe the preformationist theory, that is, embryological development. The theory describes how embryos grew from homunculi enclosed in the egg or sperm into an adult form (Roe, 1975). ‘Evolution’ in this sense was used in the original ‘spirit[1]’ of the term and meant the progressive unfolding of structures that were already present in a pre-packaged form.

By the mid-nineteenth century, the concept of ‘evolution’ experienced ‘an evolution’ as few embryologists still considered the development of the embryos as merely the expansion of pre-existing parts (Bowler, 1975). As a result, no modern evolutionists would accept the idea that species, which have appeared in the course of the earth’s history, were in any meaningful sense already present at the beginning of the evolutionary process (Bowler, 1975). Thus, later in the 1800s, the pre-existing notion of a ‘pre-formation theory’ was discredited, and the evolution of an organism (embryo) was understood as a goal-directed process, that is, a fixed program of progressive development towards a predetermined goal (Bowler, 1989).

Prior to the second half of the nineteenth century, the term ‘evolution’ was predominantly used in an embryological sense to designate the development of the individual embryo (Bowler, 1975). However, subsequently the term ‘evolution’ in contemporary discussions came to denote change in species over time. This meaning was coined around the time of the writings of Herbert Spencer (1820–1903), and particularly since the publication of Darwin’s Origin of Species in 1859, and describes historical alterations of species. Even though Darwin is often associated with the term

[1] The term ‘evolution’ has its origin from the 1620’s. Etymologically, ‘evolution’ is derived from the Latin word *evolutionem* (nominative *evolutio*) mean, "an opening of what was rolled up" or “the act of rolling”, which as in unrolling of an ancient type of book (parchment). It comes from noun of action from *evolvere*, which means to "to unfold, open out, and expand”.

'evolution', he did not use the word "evolution" in his *Origin of Species* (1859-1872), but used "evolved" as the very last word in the closing paragraph (Ayala, 2007; Bowler, 1975; Wuketits, 1990)

> "*It is interesting to contemplate an entangled bank, clothed with many plants of many kinds, with birds singing on the bushes, with various insects flitting about, and with worms crawling through the damp earth, and to reflect that these elaborately constructed forms, so different from each other, and dependent on each other in so complex a manner, have all been produced by laws acting around us…. Thus, from the war of nature, from famine and death, the most exalted object, which we are capable of conceiving, namely, the production of the higher animals directly follows. There is grandeur in this view of life, with its several powers, having been originally breathed into a few forms or into one; and that, whilst this planet has gone cycling on according to the fixed law of gravity, from so simple a beginning endless forms most beautiful and most wonderful have been, and are being* ***evolved.****"*
> [Darwin C. "On the Origin of Species by Means of Natural Selection" London: John Murray; 1859]

Charles Darwin therefore hardly used the word 'evolution', and preferred the term '*descent with modification*'; instead, the term 'evolution' was more popularized by Herbert Spencer and other biologists (Bowler, 1975). Both scholars, Darwin and Spencer, made an important step beyond the initial embryological concept, because they believed the process was open-ended, rather than goal-directed (e.g. directed toward a single goal such as man) (Bowler, 1989). However, there was a difference in opinion between Spencer and Darwin on the matter of 'progress' as a component of evolution. The first clear articulation of Spencer's evolutionary perspective occurred in his essay, 'Progress: Its Law and Cause', where evolution was described as the movement of organisms from simple to complex forms (Spencer, 1857). However, Darwin was suspicious even of this, and did not associate progressive development with the use of the term 'evolution' (Bowler, 1975). Thus evolution can be seen as a movement towards a predetermined goal or increasing level of complexity (Bowler, 1989). The remainder of this section focuses on Darwin's theory of evolution, and like Darwin, this research in examining post-adoption IS use does not assume that progress in IS use is a natural result of evolution, but that change (or modifications) also occurs over time, leading to new forms of use.

Darwin's theory of evolution is the most widely established theory of the origins of diversity (Dennett, 1995). While recognition of the process of evolution (e.g., origin of different species, changes within the same species over generations) existed prior to Darwin, the mechanism and the causality of evolutionary change became evident with Darwin's discovery of natural selection (Buss, 1987; Hull, Langman, & Glenn, 2001).

Darwin's conceptual framework of evolution comprises five (5) main theories (Mayr, 1991, p. 36): (1) *The theory of evolution* which states that the world is not constant but rather is steadily changing and that organisms are transformed in time, (2) *The theory of common descent* which posits that every group of organisms descended from a common ancestor, (3) *The theory of the multiplication* of species which explains organic diversity in which species split into daughter species or establish geographically isolated founder populations that evolve into new species, (4) *The concept gradualism* which states that evolutionary change occurs through the gradual changes in the proportion of individuals within a population (that have inherited different characteristics) and (5) The *theory of natural selection* which states that evolutionary change comes about through the production of genetic variation in every generation and relatively few survive due to a well-adapted set of inheritable characters that is passed on to the next generation.

While noting the aforementioned, Darwin's theory of evolution is generally discussed from the perspective of two major theses: *descent with modification* and the *theory of natural selection* (Futuyma, 2005).

Descent with modification presupposes that all species, whether living or extinct, descended from one or few original forms of life (Futuyma, 2005). The theory maintains that species which diverged from a common ancestor were initially very similar, but accumulated differences over large period of time, and as such there is a radical difference amongst the group (Futuyma, 2005). Descent with modification implies that from one generation to the next, organisms may come to differ from their predecessors, and hence evolution is associated with the notion that there is change over time in gene frequencies of a breeding population (Plotkin, 1997).

Darwin's theory of evolution also explains how species change adaptively by the principle of *natural selection*, which favours those species for survival, and further evolution, that are better adapted for immediate, local environment, alluding to the term 'survival of the fittest' (Back, 1996; Gould, 1976). Undoubtedly, evolution through *natural selection*, was a major scientific achievement and greatest biological breakthrough of the 19th century, and has contributed to the body of literature during the 150 years since its conceptualization in Darwin's publication '*On the Origin of Species'*

(Donahoe, 2012). In what is known as natural selection, Darwin in his autobiographical sketch, provided a vivid account of his thoughts that led to his theory (Clutton-Brock, Guinness, & Albon, 1982; White, 1947),

> *"In October 1938, that is, fifteen months after I begun my systematic enquiry, I happened to read for amusement Malthus on Population and being well prepared to appreciate the struggle for existence which everywhere goes on from long-continued observation of the habits of animals and plants, it at once struck me that under these circumstances favourable variations would tend to be preserved and unfavourable ones to be destroyed. The result of this would be the formation of a new species. Here then I had at last got a theory by which to work."*

It was then that Charles Darwin discovered the logic of evolution, which occurs with the mechanisms of *variation* (of genotypes), *selection* (of the consequent phenotype) and *retention* (of the underlying genotype). The *genotype* is the genetic makeup (set of genes) of an individual organism. Genes represent the functional unit of heredity in living organisms, which can be transmitted to future generations. They are encoded in the organisms' genetic material, that is, the DNA (Futuyma, 1998; Futuyma, 2005). In essence, the genotype encapsulates an organism's hereditary information. On the other hand, the *phenotyp*e is the physical manifestation of the genotype, and hence is the observable physical traits of the individual. These observable features include morphological, physiological, biochemical, behavioural and other attributes of an organism (Futuyma, 1998; Futuyma, 2005). The phenotype of an organism is the result of the interaction between the inherited genotype (genetic makeup of the organism) and is an expression of the organism's genes, transmitted epigenetic factors (modification to the genotype that do not alter the nucleotide sequence in the DNA) and environmental factors (non-hereditary) (Futuyma, 1998; Futuyma, 2005). While some phenotypes are entirely controlled by the organism's genes, others are as a result of environmental or non-genetic factors (Futuyma, 1998; Futuyma, 2005).

2.6.1 Variation

The theory of evolution states that all natural populations have a certain amount of *variation*. There is variation in one or more characteristics among members of a population, and there is hereditary similarity between parent and offspring entities (Futuyma, 1998; Futuyma, 2005). However, over the course of generations there may be changes in the proportions of individuals with different characteristics within populations (Futuyma, 1998).

Variation is an essential part of the evolution process, and is often dubbed the 'raw material' for evolution, as if there is no variation, then there are no alternatives to select among (Arber, 2000; Goetz & Shackelford, 2006; Hull et al., 2001; Mayr, 1991; Whitehead & Crawford, 2006).

Evolution explains that the differences between species are due to *genetic variation* and *phenotypic variation*. Genetic variation refers to changes in the genetic constitution of an organism, and occurs at the molecular level in the DNA. Phenotypic variation results from both genetic and environmental factors (Willmore, Young, & Richtsmeier, 2007), and as such individuals within a particular species may show differences (variation) in their morphologies, physiologies, and behavioural traits - their phenotype. In selection, genetic variations must be reflected not only in phenotypic variations, but the differences must also affect the individual with respect to survival and/or reproduction (Hull et al., 2001). In Darwin's publication, '*On the Origins of Species'*, he wrote the following that reflected his thoughts that both *genetic variation* and *phenotypic variation* play a role in evolution*,*

> *"The term 'variety' is almost equally difficult to define; but here community of descent is almost universally implied, though it can rarely be proved. We have also what are called monstrosities; but they graduate into varieties. By a monstrosity I presume is meant some considerable deviation of structure in one part, either injurious to or not useful to the species, and not generally propagated. Some authors use the term 'variation' in a technical sense, as implying a modification directly due to the physical conditions of life; and 'variations' in this sense are supposed not to be inherited: but who can say that the dwarfed condition of shells in the brackish waters of the Baltic, or dwarfed plants on Alpine summits, or the thicker fur of an animal from far northwards, would not in some cases be inherited for at least some few generations? And in this case I presume that the form would be called a variety" (*Charles Darwin, On the Origin of Species, 1st ed. (1859; reprinted Cambridge, Mass.: Harvard University Press, 1964), p. 44)

Variation is shaped by chance or random occurrence, and as such new variants may occur in an undirected manner (Futuyma, 2005). For example, genetic variants may spontaneously result from errors and mistakes made during replication or accidents occurring to the DNA resulting in changes in the base sequence (Arber, 2000). The process of mutation and recombination also gives rise to genetic differences. Mutation is the alternation in a genomic sequence or the DNA, and is an error in the replication of a nucleotide sequence (Futuyma, 2005). It is said to be random because the environment does not direct the probability of its occurrence, the specific mutations cannot be predicted and the likelihood of the mutation is not based on the presence or absence of an advantage (Futuyma, 1998). Recombination on the other hand, is the breaking and re-joining of DNA strands to form new molecules of DNA encoding a novel set of genetic information (Futuyma, 1998), leading to new variants.

2.6.2 Selection

The second component, *selection*, describes the mechanism that differentially favours some variants over others (Buss, 1987). This affects gene reproduction, as variants that promote fitness maximization are typically favoured, such as those that lead to longer survival, better mating opportunities, greater acquisition of resources, better defence against predators and parasites, and greater advantages for offspring (Buss, 1987).

Selection can occur through artificial or natural section. Artificial selection (or selective breeding) is intentional breeding for certain traits or combination of traits (Futuyma, 2005). It differs from natural selection as humans may favour specific traits and manipulate heritable variations in species through controlled breeding (Futuyma, 1998). On the other hand, in natural selection the environment acts as a sieve through which variants can pass, and the process is gradual and non-random (Futuyma, 2005). In essence, the selecting agents result from the operating environment wherein the variants occur, that is, both external (physical and organic elements) and intra-organismic environment (Donahoe, 2012). Types of natural selection in the biological sphere include directional selection, stabilizing selection, disruptive selection, artificial selection and frequency-dependent selection (Futuyma, 1998), which are described below (Campbell & Reece, 2008; Futuyma, 2005):

- *Directional selection* is a mode of natural selection in which a single phenotype is favoured, causing the allele[2] frequency to continuously shift in one direction.
- *Stabilizing Selection* is a type of natural selection in which genetic diversity decreases as the population stabilizes on a particular trait value.
- *Disruptive Selection* occurs when environmental conditions favour individuals on both extremes of a phenotypic range over intermediate phenotypes. As such it selects against the average individual in a population.
- *Frequency dependent selection* occurs when the fitness of a genotype varies as a function of its frequency in a given population. For positive frequency-dependent selection, the fitness of a phenotype increases as it becomes more common, while for negative frequency-dependent selection, the fitness of a phenotype increases as it becomes rarer.

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[2] Each of two or more alternative forms of a gene that arise by mutation and are found at the same place on a chromosome (Oxford Dictionary)

- *Individual selection* consists of non-random differences among different genotypes (or phenotypes) within a population in their contribution to subsequent generations.
- *Group Selection* refers to the idea that gene variants can become fixed or spread in a population because of the benefits they bestow on groups, regardless of the alleles' effect on the fitness of individuals within that group.

2.6.3 Retention

The last logic (step) of evolution is *retention*. At this juncture, only populations that survive selection are able to reproduce (Futuyma, 2005). If the population does not retain the variability from the gene pool, then the evolution of a particular species would not occur, and/or possibly vanish (Futuyma, 1998). Although selection can operate without mechanisms for retaining selected variants, the effects of the process would be transient, lacking "the cumulative quality of selective mechanisms that do carry media for retaining selected variants" (Buss, 1987, p. 1216). With heredity, traits are passed from the parents to their offspring, which causes organisms to repeat the characteristic in future generations. As a consequence, retention allows selected variants to endure in order to contribute to the pool of variation upon which future selections act (Donahoe, 2012). The favoured variations are retained through heredity, which indicates that the genes are retained (and not the traits), thus the genes provide the medium of retention (Buss, 1987; Donahoe, 2012; Futuyma, 1998; Lewontin, 1970).

In closing this section on biological evolution, it is fitting to provide an example that encapsulates the processes of variation, selection and retention. A well-known and most widely cited example of natural selection is the peppered moths *(Biston betularia),* because it is easy to understand and support for the story is concrete (Grant, 1999). Around the middle of the nineteenth century, darker varieties of this moth, which was formerly rare, began to spread through the industrial regions of middle and northern England (Breslin, 2011). Initially members of the species of moth varied in melanic pigmentation because of a single almost completely dominant mutation that had appeared in the population. Variability in colour was the result of hereditary genetic differences. The spread of the darker moths followed the appearance of coal smoke over the newly industrialized towns that, when combined with rainwater, blackened walls and tree trunks, making the lighter, pepper-coloured moths more easily visible to birds while the darker moths remained inconspicuous. Birds preyed on moths resting on tree trunks, eating the most conspicuous moths first. Moths (black ones) with a better chance of survival necessarily had a better chance to reproduce. In the countryside, the pepper colored variety increased in the course of a few days, whereas in polluted areas the melanic (darker) moths increased. Thus, the accumulation of random variability can lead to significant changes in the species in question (in this case, darker wing pigmentation) over many generations (accumulation of changes). These changes are often statistically observable in a single new generation.

2.7 Generalized Darwinism

The application of Darwin's theory of evolution to non-biological domains has now attracted lively debates as it did centuries ago (Breslin, 2011). Darwin's theory of evolution, in its most abstract form, describes a mechanism that introduces variation, has a consistent selection process and preserve and/or retain the selected variants (Campbell, 1965). Darwinists maintain that a general level of abstraction, the core set of Darwinian principles (that is, variation, selection and retention) can be used to describe evolution within a variety of non-biological domains (Aldrich et al., 2008; Hodgson & Knudsen, 2006). This framework is called '*Generalized Darwinism.*'

The premise of Generalized Darwinism is that Darwin's theory of evolution can be applied to all evolutionary processes. To contextualize 'evolution' in this sense, the term refers to a broad class of systems and populations of entities, including all feasible manifestations of development and change (Hodgson & Knudsen, 2006). With this definition in mind, Generalist Darwinists argue that under some minimal conditions, it is understood that on-going change in systems is inevitably Darwinian, in the sense that it must involve Darwin principles (Hodgson & Knudsen, 2006).

Support for the use of the concepts of variation, selection and retention in non-biological domains dates back to Charles Darwin (Hodgson, 2005). Darwin speculated that the evolutionary principles of variation, selection and retention may be applicable to the evolution of human language, moral principles and social groups (Hodgson, 2005). In this manner, Darwin acknowledged the potential broader significance of his core concepts, proposing that natural selection can operate on the elements of language, for example, with natural selection favouring tribal groups with moral and other predispositions that served the common good (Aldrich et al., 2008). Scholars, over a century ago, have also argued that the evolutionary principles are applicable to the survival of individuals, groups, customs, nations, organizations and other social institutions (Aldrich et al., 2008; Hodgson, 2002). In essence, Darwin's theory is applicable also to mental, epistemological, moral, social evolution (Hodgson, 2002).

Despite critics who argue against 'Generalized Darwinism' on the premise that there are differences between biological spheres and other domains (Cordes, 2006; Witt, 2008), advocates claim that the idea and agenda of generalizing Darwinism "has little to do with biological metaphors or analogies" (Aldrich et al., 2008, p. 579). The notion of Generalized Darwinism does not claim that change in social or economic phenomena must be explained in biological terms, and importantly Generalized Darwinism is not a version of biological reductionism and thus logically does not apply principally or exclusively to biology (Aldrich et al., 2008). As related by (Metcalfe, 2005, p. 10)

> *"...the concept of an evolutionary process is quite independent of its application to any particular set of phenomena. That evolution is a core concept in biology does not mean that it is an inherently biological concept. Evolution can happen in other domains providing that conditions for an evolutionary process are in place...we can learn from the debates on evolutionary biology in order to understand better the logical status of concepts such as fitness, adaptation and unit of selection within in any sense needing to absorb the associated biological context."*

Generalized Darwinism maintains that there are indeed ontological differences at the level of detail in biological and social domains; however, at an abstract level, there are common ontological features (Hodgson & Knudsen, 2006). As such, claims by critics that Generalized Darwinism "supposes that there is only one and the same ontological basis for all evolutionary phenomena" (Witt, 2004, p. 128) is falsified (Hodgson & Knudsen, 2006). Instead, Generalized Darwinism is grounded in the belief that Darwinism encapsulates a broader and more general set of principles that is not confined to biology and entails "a basic philosophical commitment to detailed, cumulative, causal explanations" (Hodgson, 2002, p. 259). Thus, it is contended that Darwinian principles of variation, selection and retention are applicable to non-biological domains, such as social and economic systems (Aldrich et al., 2008; Hodgson, 2002; Hodgson & Knudsen, 2006, 2008).

Furthermore, applying analogies is not the agenda of Generalized Darwinism as it would bind the discussion too closely to biology (Nelson, 1995). Using analogies and metaphors can run the risk of searching for such analogies and metaphors, even when it is irrelevant to the domain of interest (Nelson, 1995). This can result in inaccurate, duplicitous, and false claims (Aldrich et al., 2008). So although some scholars have used vernacular from biological evolution, and in some cases close analogies to investigate a phenomena of interest (Nelson, 1995), Generalized Darwinism is not confined to considering the evolutionary process as always that of genetic variation and selection (Hodgson, 2005).

Therefore, although evolution in other domains may differ from biological evolution, the concept of Generalized Darwinism can nonetheless be used as a starting point for the development of change theory (Breslin, 2011). Darwinism explains open, complex system, with 'open' being characterized as systems that require resources from their environment to function and 'complex' being described as systems composed of interacting elements (Stoelhorst, 2008b).

Darwinian principles applied to other domains maintain that it is an algorithm which asserts that once there exists a mechanism for introducing variation, a consistent selection process and a mechanism for preserving and retaining favourable variants, then evolution will occur (Campbell, 1960; Dennett, 1995). With Darwinism, change is a continuous and open-ended process, and the state of affairs at time 't' represent the initial conditions for the process of variation, selection and retention that generates increased variety at time 't+1' (Stoelhorst, 2008d).

The sentiments expressed by Generalized Darwinism, on a basic methodological level, embodies that (i) all social sciences should entail a 'detailed, cumulative and casual explanations', (ii) a causal explanatory logic in essence applies to all evolutionary processes, and (iii) that all processes in the social and natural sphere share similar ontological structure (Schubert, 2013). As such, Darwin's mechanism of variation, selection and retention can offer a framework to model changes in other systems (Aldrich et al., 2008; Hodgson, 2002; Hodgson & Knudsen, 2006, 2008).

Generalized Darwinism is therefore posited as a broad theoretical framework for the analysis of the evolution of systems. Broadly speaking, applications of Generalized Darwinism must involve an adequate explanation of the evolution of such systems (Hodgson & Knudsen, 2006). Failure to incorporate the three (3) principles (i.e. variation, selection and retention) will result in an inadequate explanation of evolution (Hodgson, 2006). Notably, Generalized Darwinism is not a complete theory, as the mechanisms do not themselves provide all the necessary details (Hodgson, 2006). Instead Generalized Darwinism is a set of abstract concepts that require domain-specific auxiliary theories to offer a greater explanatory account of how and why change occurs (Hodgson, 2002). It therefore requires additional middle range theories to detail the operation of mechanisms of variation, selection and retention for the system of interest (Stoelhorst & Huizing, 2006).

It can therefore be seen from the above arguments, that Generalized Darwinism makes substantial use of Darwinian concepts, that is, the principles of variation, selection and retention in other domains (that is, non-biological domains). It serves as a general and/or abstract level of reduction of Darwin's theory of biological evolution to other forms of evolution (Breslin, 2011; Cordes, 2006; Hodgson & Knudsen, 2006). Advocates of Generalized Darwinism maintain that it is not limited to use in a heuristic or metaphorical form only as the biological and social spheres are not identical, and while the theory cannot explain everything, it is useful as a starting point for the development of theory in other domains (Aldrich et al., 2008; Hodgson, 2002; Hodgson & Knudsen, 2006, 2008).

In short, due to the high degree of generalizability that Darwinian principles operate within, Generalized Darwinism does not provide a complete theory of everything from cell to human society, and more importantly it does not claim to explain every aspect or detail of change (Hodgson & Knudsen, 2006). Thus, Generalized Darwinism, by itself, does not provide full and complete answers, but offers a general and/or meta-theoretical framework, which requires additional and context specific explanations to provide a sufficient understanding (Hodgson & Knudsen, 2008). Even Darwin himself proclaimed "*...several facts accord well with my theory. I believe in no fixed law of development*" Darwin (1859, p. 314).

The following section provides details on variation, selection and retention in the context of Generalized Darwinism.

2.7.1 Triumvirate of Variation, Selection and Retention

Generalized Darwinists argues that a Darwinian framework has a high degree of generality, which provides a meta-theoretical structure of over-arching principles that can be used to frame and explain change (Hodgson & Knudsen, 2006). It mirrors the theory of natural selection which specifies a recursive casual logic of the mechanisms of variation, selection and retention (Stoelhorst, 2008b). Generalized Darwinism applies these mechanisms as the '*explanantia*' of the theory (Stoelhorst, 2008d). This section discusses the three (3) generic principles of evolution (variation, selection and retention) within the scheme of Generalized Darwinism, which will underpin the theoretical explanation of change in IS use in this study.

2.7.1.1 Variation

The term 'variation' dates from the 14th century from the Old French term 'variation', which in turn comes from the Latin word *variationem (nom. variatio)*, which means "a difference, variation, change," which comes from variatus, past participle of variare "to change."

Variation is often dubbed the 'raw material' for evolution, from which selection can be made (Mayr, 1991). Variation in the characteristics of organisms is exhibited in differences among individuals within a population and among populations and species (Buss, 1987). There must be variation for the process of selection to operate.

In biological systems, variation is argued to be shaped by chance or random, thus the new variants will tend to occur in an undirected manner (Futuyma, 2005). Variation occurs as a result of mutation (that is, changes in a genomic sequence or the DNA) or recombination (that is, breaking and re-joining of DNA strands to form new molecules of DNA encoding a novel set of genetic information) (Futuyma, 2005). Generalized Darwinism however does not seek to mimic or provide an analogy of mutation and recombination as there are often no close analogous mechanisms in the evolution of social institutions (Hodgson & Knudsen, 2006). Likewise, elements such as sexual reproduction, mutation or speciation are absent in cultural evolution, which further supports the notion that the sources of variety in biological and other spheres are ‘fundamentally different’ (Cordes, 2006).

There are forces that continue to introduce new variety in a system, conceivable as further ‘grist for the selection mill’, geared towards new departures that seem appropriate to the non-biological contexts (Nelson, 1995). Thus, variation plays a crucial role in an evolutionary model, as there must be some explanation of how variety occurs and how it is replenished in a population (Hodgson & Knudsen, 2006). Hence, the source of variation is paramount in explaining its behaviour (Cordes, 2006).

Similar to biological evolution, variation in other domains can emerge by blind or random chance or unpredictable change or events (Van de Ven & Poole, 1995). For example, variation can be performed by recombination and by accidental changes. Recombination occurs from introducing specific characteristics known from elsewhere or by applying existing characteristics that were created randomly (Geisendorf, 2009). Accidental changes occurs from mistakes, misunderstandings, surprises and idle curiosity (Geisendorf, 2009).

On the other hand, the evolution of social institutions also includes elements such as planning, imitation and other mechanisms that are different from the detailed processes in biology (Aldrich and Ruef, 2006). As such variation (and/or variety generation) in non-biological domains can also be intentional, deliberate and directed and or planned, for example, when individuals deliberately attempt to generate alternatives and/or new solutions to problems (Aldrich, 1999; Nooteboom, 2008).

Despite the differences, the “general problem of the existence and replenishment of variety remains a vital question of evolutionary research in the social and technological domain” (Aldrich et al., 2008, p. 584). In generalizing and applying the concept of ‘variation’ to an evolutionary system, it specifies a variation mechanism which increases variety in the characteristics of the entities of the set (Stoelhorst, 2008d). This is critical as selection requires variety and if replenishment of variety is absent, then evolution will desist. Besides variety, the source of variation should be considered as it is important to specify where this variety comes from (Stoelhorst, 2008d). Although biological and other domains are admittedly dissimilar, as established earlier, the mechanisms can be generalized to understand the manner in variation works: by changes in the individual building blocks of a system, or by establishing new combinations of these building blocks (Stoelhorst, 2008d).

2.7.1.2 Selection

The word 'selection' originates from the 17th century from the Latin term *selectionem*, a noun of action which derives from the past participle stem of *seligere* which means to "choose out, select." In Generalized Darwinism, selection includes some set of mechanism(s) that brings about the survival of some variations rather than others (Hodgson & Knudsen, 2006).

In biological evolution, the process of natural selection is a gradual and non-random one, whereby biological traits become either favoured or not favoured in a population as a function of differential reproduction of their bearers. The selecting agents result from the operating environment wherein the variants occur, that is, both the external (physical and organic elements) and the intra-organismic environment (Donahoe, 2012).

While biological evolution emphasizes the environment in the process, Generalized Darwinism argues that the individual also plays a role as a decision maker in the selection process (Furneaux et al., 2010). With Generalized Darwinism, the process of selection can operate by way of "conscious choices, competitive pressures, market forces, or environmental constraints," operating on "habits, customs, technologies, institutions, regions and even whole economies" (Hodgson & Knudsen, 2006, p. 10).

In essence, selection constitutes forces that differentially select or selectively eliminate certain types of variations, and is not limited to the environment (Aldrich, 1999). Selection can result, for example, from fit between organizations and environment, fit to target aspiration levels or existing organizational knowledge, conformity, desire to minimize transaction cost (Aldrich, 1999). It can also result from managerial action on the basis of pre-established goals, values, criteria, checkpoints, or competition (Dooley, 1997).

Through the lens of Generalized Darwinism, the outcome of the selection process is not necessarily moral or just (Aldrich et al., 2008). This is so as politically organized communities humans may impose moral constraints on social processes by adopting 'rules of the game' that replace natural selection by artificial or purposeful selection (Aldrich et al., 2008).

As an example, Nelson (1995) provided a relatively simple illustration of selection, using a house design scenario. In his illustration, it is first assumed that the original house design is a tentative one, because the builder is not exactly sure how to achieve what he or she wants. The plan initially contains certain elements without any firm commitment to them, which are assumedly there partly by chance. As the building gets constructed, the builder gets a better idea of what the present plan implies, and where the original design is inadequate. Consequently, the builder revises the plan and the path of construction accordingly. Accordingly, the design elements that turn out to please or displease the builder are accepted or rejected accordingly (Nelson, 1995).

It should be noted that the above illustration is not explicit about what seems to give advantage, however it indicates the builder might be able to find out (Nelson, 1995). For example, the builder might have revised the design based on cost per square foot or nicely shaped spaces or some combination of information that he or she receives (Nelson, 1995). Thus, selection depends on the characteristics of the selected objects in regards to a number of criteria (Geisendorf, 2009).

Caution should be taken however in the assumption that the selection outcome should be optimal or an improvement on their precursors (Aldrich et al., 2008). The outcomes may imply refinement or efficiency, however it is efficient relative to the given environment, and that is tolerable rather than optimal (Aldrich et al., 2008). Notably, also the notion that selection results in global efficiency or (near) optimal outcomes is not an assumption of Darwinism, as the outcome can also bring about systematic errors (Hodgson & Knudsen, 2008).

Whatever the reason is, that is, the decision guiding selection and/or the outcome, it is important to note that evolutionary theory has limited explanatory power until the question of the selection criteria gets answered (Nelson, 1995). However, when that question is adequately answered, the theory can explain, and to some extent, predict the outcome (Nelson, 1995).

The principle of selection is as essential in the social domain, as it is in the biological domain. In the biological sphere, without it, there is no explanation as to how some entities or their offspring prevail over others (Hodgson & Knudsen, 2006). Likewise, even if there is not a fierce life-and-death struggle between rival customs or institutions, there is still the need to explain why some enjoy greater longevity than others, why some are imitated more than others, and why some diminish and decline (Aldrich et al., 2008).

In essence, with any evolutionary system, new variants are generated. Some of the variants are propagated while others are not, thus an explanation guiding choices is paramount and encapsulated in the ‘general rubric’ of selection (Aldrich et al., 2008; Geisendorf, 2009). Furthermore given Darwin’s ontological position that everything is subjected to a ‘casual explanation’, the phenomenon of humans selecting should not be ignored but rather the calculation and intention should be explained (Hodgson & Knudsen, 2006). In the social sciences, for example, it is often taken for granted that the concept of human intentionality is adequate to explain a person’s action, without delving into the causes and/or underlying reasons for the intention itself (Hodgson & Knudsen, 2006). This is considered insufficient from a Generalized Darwinism perspective, which seeks to probe the causes behind intention and/or action, thus providing an explanation of how agents formulate and revise goals and generate new alternatives (Hodgson & Knudsen, 2006).

2.7.1.3 Retention

The term 'retention' dates from the 14th century being derived from the Latin word *retentionem* (nominative *retentio*) "a retaining, a holding back," from past participle stem of *retinere,* which means to "keep (another) attached to one's person, keep in service." Retention is the third phase in the evolution process, where selected variants are retained, preserved, duplicated, passed on, copied through time or otherwise produced (Aldrich, 1999; Aldrich et al., 2008).

Within the context of Generalized Darwinism, it is necessary to include mechanisms that stipulate how 'adaptive solutions' are passed on (Hodgson & Knudsen, 2006). Retention permits selected variants to persist and thus contribute to the variation upon which future selections act (Donahoe, 2012). In biology, genes and DNA are an essential part of the retention mechanisms. However through the lens of Generalized Darwinism, in social evolution, for example, retention may include replication of habits, customs, rules and routines, all of which may carry solutions to adaptive problems (Hodgson & Knudsen, 2006). As such, retention preserves what has survived the selection process.

With regards to retention, there is a debate about replication by a mechanism of inheritance. Advocates of Generalized Darwinism propose that with socio-economic domains, replicators such as habits and routines are similar in the sense that they can make copies of themselves (Knudsen, 2002). However critics argue that there is no direct analogy to the gene, as there are no cultural entities that actively replicates themselves like DNA (Cordes, 2006). Proponents maintain however that Generalized Darwinism does not seek to find an analogy, but argues that replication is achievable by cultural transmission (for example) where adaptive behaviours are passed on to the next generation (Stoelhorst, 2008a).

Nonetheless, Generalized Darwinism can be explained without a focus on replication, with 'continuity' being a key facet, as accentuated by Stoelhorst (2008c)

> *"All that is needed for the Darwinian algorithm to work is that the systems at time t resemble the systems at time t-1 in terms of their characteristics. What is important is not replication, but continuity over time. Given mechanisms of variation and selection, all that is needed to evolve adaptive fit is a 'memory' that maintains the characteristics that have previously been selected. These observations allow us to generalize the function of the inheritance mechanism in the overall Darwinian algorithm: an inheritance*

mechanism maintains the characteristics favored by selection in the set of entities” (p. 353)

In summary, an equally significant aspect of the Generalized Darwinism is retention, as there should exist some mechanism which allow selected variations to endure and replicate (Hodgson & Knudsen, 2006). The existence of such mechanisms will explain how useful information concerning solutions to particular adaptive problems is retained and passed (Aldrich et al., 2008), otherwise the continuing retention of useful knowledge would not be possible (Hodgson & Knudsen, 2006).

2.7.1.4 Summary

This section reviewed the concept the concept of Generalized Darwinism. This research seeks to apply the mechanisms of variation, selection and retention to the study of IS use, that is to understand how and why changes in IS use occur. This study shares the ontological assumption of Generalized Darwinism (i.e. evolution) which argues that (i) There is change; (ii) The change is caused and there is a need for causal explanations of how things change; (ii) Continuity exists and an explanation of change should demonstrate how the state of things at time t+ 1 is derived from the state of things at time t and lastly that (iv) Change takes place at multiple, interrelated levels of analysis (Stoelhorst, 2008d).

It is important to note that the use of Generalized Darwinism in this dissertation does not make use of terms that are specific to biology, and avoids genetic analogies and metaphorical arguments in understanding changes in the use of IS over time. Rather, it applies Darwinian principles using Generalized Darwinism as a general explanatory framework to explain and understand change in IS use. Mindfully, Generalized Darwinism itself cannot offer a full, detailed explanation of evolutionary processes or outcomes, but provides a general explanatory framework in which particular explanations or specific theories must be nested (Hodgson, 2002, 2005). As such, this research applies Generalized Darwinism as a meta-theoretical framework rather than a complete theory, thus other theories will be used to complement and/or support the proposed model.

The next section examines ‘routines’ which is a key ingredient in explaining changes in IS use within the Generalized Darwinism framework.

2.8 Micro-foundations of Routines

All theories of evolution are concerned with change over time, and the basic theory of biological evolution is the notion that species change (Stoelhorst, 2008b). In using an evolution metaphor, a key question that should be answered is 'what actually evolves' (Devezas, 2005). Put another way, in the casual logic of Darwin algorithm, it is key to identify "what is selected and how does this selection take place? (Stoelhorst, 2008d). In the context of this research, an equal question is 'What should be the suitable unit of analysis in examining post-adoption IS use from an evolutionary perspective?' This section will focus on routines, in particular IS-enabled routines at the individual level of enactment as the unit of analysis in applying the Generalized Darwinism framework.

The concept of *routines* is at the heart of organizational studies (Felin & Foss, 2004), and has been fundamental in the application of evolutionary concepts to areas such as evolutionary economics and organizational capabilities (Aldrich, 1999; Becker, 2004; Pentland, Feldman, Becker, & Liu, 2012), providing the 'central unit of analysis' (Becker, 2004). It is widely accepted that routines is explicitly a collective phenomenon rather than individual-level phenomena (Nelson & Winter, 1982). As such, early scholars have failed to provide a micro-foundation for routines, by applying a collectivist mode of theorizing routines, which sidesteps numerous individual-level considerations such as individual's actions (Felin & Foss, 2004). The collectivist roots of routines sidelines the individual and in most cases scarcely allows for explanation at the individual level (Felin & Foss, 2004). This however is not sufficient as individuals provide the 'nested antecedent' to a number of collective phenomena (Elster, 1989), which suggests that careful theoretical and empirical consideration of individuals is required in theorizing routines.

There have therefore been calls for individual-level considerations in collective notions (such as routines) by scholars such as Herbert Simon who underscore that "nothing is more fundamental in setting our research agenda and informing our research methods than our view of the nature of the human beings whose behavior we are studying' (Simon, 1985, p. 303). However, to date, there has been little emphasis on individual-level considerations with limited focus on establishing a link between individuals' interest and cognition and organizational routines (Felin et al., 2012).

By ignoring individuals in understanding the collective nature of routines, the implicit assumption also is that individuals are homogeneous and that the collective heterogeneity is what accounts for the overall outcome (Felin & Foss, 2004). However this suppresses and/or eliminates what Felin and Foss (2004) calls the 'who' question(s), as how things are done in organizational settings, both in terms of structure and overall efficiency or creativeness, is a function of *who* is performing the act.

Thus, despite the pervasive collective level focus of routines, there is a need to rethink the underlying assumption about the role of individuals. Within a routine, each individual within the organization must learn their parts within the routines (Cohen & Bacdayan, 1994) and as such the talents and skills of individuals should not be brushed aside (Felin and Foss, 2004). Thus in examining evolution, it is plausible to conceive of routines not only as a collective phenomenon, but also at a micro-level, as organizations are made up of individuals and it is the individuals rather than organizations that act and behave (Felin and Foss, 2004).

An often cited definition refers to routines as '*repetitive, recognizable patterns of interdependent actions, carried out by multiple actors*' (Feldman and Pentland, 2003, p. 95) or '*recurrent interaction patterns involving multiple actors working to achieve a particular outcome*' (Becker, 2005, p. 818). A closer look at key terms such as 'multiple actors' or 'interdependent' shed greater light on the definition, and can help inform calls for a micro-level focus on the individual role in organizational routines.

With regards to '*multiple actors'*, Feldman and Pentland (2003) highlights that organizational routines in its original conception entail coordination of multiple organization participants, hence it is understandably not just the individual routines that are performed in the context of an organization. However, since multiple individuals are involved, this introduces diversity in the information, interpretive schemes, and goals of the actors. In dissecting the term '*interdependent actions'*, Feldman and Pentland (2003) acknowledged that due to the interdependent nature individuals' actions, routines are rightly classified as a collective performance. Thus, similar to dancers, participants in an organizational routine must adjust to each other's actions (Feldman & Rafaeli, 2002). Nevertheless, although actors in an organizational routine 'cannot just act as they please', due to the interdependent nature of the routine, individuals do play a role in their action or search or decision process (Feldman & Pentland, 2003).

The role of the individual in routines resonates in the call for a micro-foundation outlook, as routines are in actuality epiphenomena, which may blur the understanding of foundational and theoretical individual-level effects. (Felin & Foss, 2004). To explain a collective phenomenon (such as institutions, organizations, or culture), studies should show how routines "arise as the result of the action and interaction of individuals" (Elster, 1989, p. 13). Thus routines, although a collective phenomenon, should be grounded in explanatory mechanisms that entail the individuals' actions, interactions, endowments, intentions, desires, expectations, goals and motivations (Abell, Felin, & Foss, 2008; Felin & Foss, 2004).

Understanding routines at the micro-level requires that individuals are seen as more than a cog in the wheel, thus acknowledging that individuals (within organization) have various a priori predispositions, experiences, characteristics, talents, and abilities (Felin & Foss, 2004). By delving further into the individual level elements such as individual behaviour, cognition and emotion, this offers a deeper understanding of change, and responds to calls for a better understanding of the micro-foundation of routines (Parmigiani & Howard-Grenville, 2011).

The following section will discuss how the micro-foundation for routines is applied in the context of this research to understand change in how individuals' use IS from an evolutionary perspective.

2.8.1 Evolution of IS-enabled Routines

Feldman and Pentland (2003) developed an 'influential theoretical account' of routines, proposing that it involves two elements: an '*ostensive*' and a '*performative*' aspect. The ostensive aspect refers to the description or abstract of the routine, while the performative aspects is the actual enactment of the routine, that is, performance by specific individuals at specific times in specific places (Feldman & Pentland, 2003).

This research focuses on the performative aspect of routines, which is essential for the creation, maintenance, and modification of the ostensive aspect, much in the same that speaking creates, maintains, and alters a language (Feldman & Pentland, 2003). Performances are the specific actions taken by specific people at specific times as they engage in an organizational routine (Feldman & Pentland, 2003). For individual practices, although conducted against a background of rules and expectations, there is some choice in their 'course of action' as participants engage in reflective self-monitoring. This is plausible even in situations where there are constraints, and does not discount that unreflective, habitual action is certainly possible (Feldman & Pentland, 2003).

Practices can be inherently improvisational as individuals reflect and interpret their actions to make sense of their actions (Feldman & Pentland, 2003). Although participants' choice of how to proceed may appear automatic at times, there is the possibility of resisting expectations and doing otherwise (Feldman & Pentland, 2003). Routines are inherently improvisational, as individuals can improvise in enacting routines, and the degree of divergence may vary from minor adjustments to total re-invention.

In the context of this research, the focus is on individuals' use of IS, with an emphasis on their enactment of organizational routines, that is, the performative aspect of the routine. As succinctly stated by Feldman and Pentland (2003), without the performative, nothing ever happens. This is further justified by the argument that organizational routines tend to performed by individuals using tools, such as the IS, to carry out tasks (Bapuji, Hora, & Saeed, 2012). In performing specific actions, individuals engage in 'effort accomplishments' (Pentland & Rueter, 1994) as they construct their routines from a repertoire of possibilities in how the IS can be used.

Since performances enact the ostensive aspect of the routine, a focus of the performative aspect reintroduces the role of the individual in 'creating and shaping' routines, and the importance of agency and subjectivity. In supporting research on micro-foundation of routines, it is essential to also understand the lower-level/micro entities, that make up the 'collective', which includes the individuals, processes and interactions in the organizations (Felin et al., 2012).

Thus in observing change in IS use, this research focuses on of the IS-enabled routine by applying elements of variation, selection and retention to explain changes in the individuals' use of IS (to perform their work routines). The following will provide further details on how these three (3) elements may play a role in change in IS use in supporting ones' work routine.

2.8.1.1 *Variation*

Variation is often dubbed the raw material for evolution; as for selection to work there must be significant differences between the individuals making up the population (Futuyma, 2005). Without a rich variation, selection processes have no material to work on (Aldrich et al., 2008).

Applied to the organizational literature, variation denotes change in current routines, competencies, practices, and organizational forms (Aldrich & Ruef, 2006; Johansson & Siverbo, 2009). Variation can therefore be defined as any "departure from routine or tradition" (Aldrich, 1999, p. 22) or "where individuals or groups of them generate a set of ideas on how to approach old problems in novel ways or to tackle relatively new challenges" (Zollo & Winter, 2002, p. 343) or "heterogeneity of alterations of existing forms" (Campbell, 1974, p. 143), or the "generation of new ways of doing things" (Furneaux et al., 2010, p. 4).

In the context of this research, it is presupposed that the IS provides a repertoire of features that users can use to support and/or perform a routine. This research however focuses on variation in post-adoptive behaviours, that create variety in how the IS can be used to perform work tasks and, represents a departure from ones' normal routine.

Individuals are relatively free to enact technologies in different ways, and can thus improvise, innovate, and adjust their work routines over time (Orlikowski, 1996). They can use it minimally, invoke it individually or collaboratively, and improvise in ways that produce novel and unanticipated consequences (Boudreau & Robey, 2005). These actions help create variations.

Furthermore, variation may also come from the process of searching for new and better ways of doing things (Nelson & Winter, 1982) as they apply the IS. Alternatively, variation can also arise through innovation or the recombination of existing routines (Nelson and Winter, 1982). Moreover, intentional variation can occur when individuals attempt to generate alternatives to resolve a problem or situation via actions such as planning (Aldrich & Ruef, 2006). In this sense, individuals are deemed to want to change elements of their use of the IS and so alter the way they do their jobs.

Through variations, individuals may therefore partake in a range of different actions and/or behaviors in their interaction with the IS. For example, they may apply unused features, apply already-used features at higher levels of use, discover new uses of existing features, or identify the need to incorporate new features into the IS (Jasperson et al., 2005). Altogether, these may create alternatives in how they perform their work. It is important to note also that individuals may have different beliefs, goals, and interests that inform and affect their choices in how they use the IS (Felin et al., 2012). Individuals bring different types of human capital (skills, knowledge, experience, cognitive capacities) and characteristics to an organization. Thus variation in these dimensions may influence the routines that arise from organizational members and their interactions (Felin et al., 2012).

2.8.1.2 *Selection*

Selection refers to forces that differentially select or selectively eliminate certain types of variations (Aldrich, 1999, p. 26). Studies have found that feature use and selection varies over time (Hiltz & Turoff, 1981; Kay & Thomas, 1995), and thus the mechanism by which selection occurs should add value to understanding the change process.

In this research, the focus is primarily on selection at the individual level. This re-introduces the concept of agency, that is, the role played by human purpose (Nelson, 2006). For example, an individual may contemplate a range of possible actions before actually choosing one and putting it into practice (Nelson, 2006). In this respect, an important part of the selection process involves the winnowing of alternative ideas for action before final action is taken (Nelson, 2006). As such, different actors can be a source of selection, as because routines are enacted by many people, there are many actors who influence the process of selection (Feldman & Pentland, 2003).

Selection can be retrospective, in the sense that individuals look back on the past to guide future decisions. Individuals may select different pieces of performances for any number of reasons such as ease, familiarity, guile, or personal gain, or if it is better than the average of the performances currently retained (Pentland et al., 2012). Routines thus selected can be for conferring some advantage. However, the selected routines may not always be optimal as the learning process may involve "imperfect adaptation and mistake-ridden discoveries" (Dosi & Nelson, 1994, p.159). Furthermore, selection techniques are not always effective as it can involve selecting an outcome that is no longer relevant because the environment has changed (Pentland et al., 2012). In essence, variation necessarily supplies evolution with 'fuel for the fire', but it is selection that controls the direction of the fire and possibly extinguishes it (Johansson & Siverbo, 2009), thus determining the direction of change in IS use.

2.8.1.3 *Retention*

While selection focuses on evaluation, it does not result in the generation of new routines or sub-routines, but rather it entails a decision about whether or not to keep, or retain existing routines (Feldman et al., 2003). On the other hand, in *retention*, selected variations are preserved, duplicated, or otherwise reproduced (Aldrich, 1999). Simply put, retention within organizational routines occurs when individuals turn a variation into part of the story about how they perform a task(s) (Feldman & Pentland, 2003).

Routines, for example, may be retained if they are seen to perform adequately (achieve the outcome desired) (Knudsen, 2008). When a process is selected and performs well, it is likely to be selected again, however, a process, which is selected, and does not perform well, is unlikely to be chosen again (Denrell & March, 2001).

Sentiments of continued use, in the IS literature, echoes this notion of retention. Retention in IS use is paramount, as continued use is critical for IS success (Bhattacherjee, 2001; Kim & Malhotra, 2005). In the context of this study, retention of (at least some) variations in use is important, so that the selected variations can be repeated on future occasions (Aldrich, 1999) to reap the benefits of the IS. With retention, the outcome is evident with changes in use over time (Orlikowski, 2000; Orlikowski, Yates, Okamura, & Fujimoto, 1995; Sun, 2012; Sun & Zhang, 2008).

In summary, within organizations, individuals develop collective routines specific to the completion of the different tasks associated with one's roles (Breslin, 2011). Individuals can then select a particular routine for each task and subsequently enact the routine (Breslin, 2011) through use of the IS. Take for example, the use of a Customer Relationship Management (CRM) System for completing a task such as 'report generation'. Individuals within the firm can choose from a collective routine associated with that task, or they can choose to carry out the task using other aspects (features) of the IS that they have learnt for themselves. Also, the individual can attempt to vary by changing their individual 'report generation' routine or by even persuading others to alter the more collective 'report generation' routine. Once the individual selects a particular variation, the routine is then enacted through the individual's actions, and thus over time if preserved (retained through continued use), it becomes a part of a new routine. Alternatively, it may be discarded (that is, discontinued use) and the individual returns to the old variant or a new variant is tried and selected.

Nelson and Winter (1982) argue that organizations in general have a wide variety of specialized routine performances, each customized for a particular configuration of the environment, from which members can retain in repertoire the specialized individual routines involved. Consequently the variants of a particular routine compose the repertoire of different ways of achieving a particular outcome in an organisation (Pentland & Rueter, 1994) through IS use. Thus, varieties of a single routine become a repertoire from which individual performances of a routine can be selected (Feldman, 2000).

The example of 'report generation' and the arguments above in this section allude to the stance that evolution can occur over time in an individual's post-adoptive behaviour. Individuals rather than operate from a fixed repertoire in the enactment of routines, as they use the IS, may extend their repertoire. Similar to grammar (Pentland & Rueter, 1994), this entails a set of possibilities from among which users may select and retain various features to accomplish work routines. This study therefore seeks to understand how individuals change or revise the features in use over time, with the focus on the actions of the individuals as they interact with the system to enact and/or perform work routines.

2.9 Chapter Reflection

This chapter reviewed the literature on post-adoption IS use and justified the need and/or relevance for a change focus. Using evolution as a lens for change, Generalized Darwinism is proposed in this research as a meta-theory to help understand and explain how individuals' use of an IS changes over time. As discussed, in applying an evolutionary perspective to understand changes in post-adoptive behaviours, this research focuses on the '*performative*' element of the routine, that is, how individuals use the IS to enact work routines. Drawing on an evolutionary change framework, this research also seeks to identify and examine factors that enable and/or inhibit individuals to change how they use an IS to accomplish work tasks. The final outcomes will include identifying factors that influence change and providing suggestions for encouraging users through change, to leverage the potentials of the IS to enhance their work. The next chapter (Chapter 3) will discuss the methodology used in this study to understand change in IS use.

Chapter 3. Research Design and Methodology

"In the most elementary sense, the design is the logical sequence that connects the empirical data to a study's initial research questions and, ultimately, to its conclusions. Colloquially, a research design is an action plan for getting from here to there, where here may be defined as the initial set of questions to be answered, and there is some set of conclusions (answers) about these questions. Between here and there may be found a number of major steps, including the collection and analysis of relevant data." (Yin 1994, p. 19)

3.1 Chapter Overview

This chapter describes the research design and the methods used to investigate and understand individuals' change in post-adoption use of IS over time, and to ultimately answer the research questions (See Chapter 1). This chapter is structured using a framework put forward by Crotty (1998) which states that some important elements and/or levels in developing a research study include: the paradigm, that is, the epistemology and ontological beliefs; the methodological approach, and the methods of data collection. The first section of this chapter discusses the philosophical assumptions (worldviews) and states the philosophical stance of this research. The next section details the mixed method approach applied in this research, with thorough descriptions of the data collection and analysis procedures for both the qualitative and quantitative aspects of this research.

3.2 Underlying Philosophical Assumption: Ontological and Epistemology Underpinning

Worldviews are the broad philosophical assumptions researchers use when they conduct studies, and refer to a set of beliefs and assumptions about knowledge that guide actions (Creswell & Plano-Clark, 2011). Worldviews differ in their perspective of the nature of reality (ontology), the nature of knowledge (epistemology) and the role that values play in research (axiology), and the process of research (methodology) (Creswell & Plano-Clark, 2011). Before the chapter discusses the different worldwide views and the stance of this research, it is important to define the notions of ontology and of epistemology.

3.2.1 Ontology

Ontology is essentially the starting point of all research, after which one's epistemological and methodological positions logically follow (Grix, 2002). Ontology refers to the philosophical assumptions about the nature of reality (Creswell & Plano-Clark, 2011; Easterby-Smith, Thorpe, Jackson, & Lowe, 2008; Saunders, Lewis, & Thornhill, 2009) and encapsulates one's assumptions about the way the world operates (Saunders et al., 2009). Providing a more detailed definition, Blaikie (2000, p. 8) describes ontology as claims and assumptions that are made about the nature of social reality, claims about what exists, what it looks like, what units make it up and how these units interact with each other. In short, ontological assumptions are concerned with what we believe constitutes social 'reality', and determines how researchers conduct their enquiries and the interpretation of data collected (Saunders et al., 2009).

There are two aspects of ontology: objectivism and subjectivism (Saunders et al, 2009). Objectivism posits that social entities are external (Saunders et al., 2009), that is, social phenomena and their meanings have an existence independent of social actors (Bryman & Bell, 2003). On the other hand, subjectivism holds that social phenomena are created from perceptions and consequent action of social actors. This ontological position asserts that social phenomena and categories are not only produced through social interaction, but are also in an on-going state of revision (Bryman & Bell, 2003).

3.2.2 Epistemology

Epistemology, one of the core branches of philosophy, is concerned with the theory of knowledge, particularly in regard to its methods, validation and the potential ways of gaining knowledge of social reality, whatever it is understood to be (Grix, 2002). It concerns what constitutes acceptable knowledge in a field of study (Saunders et al., 2009), or what is regarded as acceptable knowledge in a discipline. Thus, epistemology is about how we come to know what we know (Grix, 2002).

3.2.3 Worldviews (Paradigms)

This section in the methodology considers four (4) worldviews as put forward by Creswell and Plano-Clark (2011): *Post-positivism*, *Constructivism*, *Participatory* and *Pragmatism*. Table 3.1 shows the common elements, the different worldviews, and how the elements and worldviews are translated into practice. This portion of the chapter discusses the worldviews in relation to the ontological and epistemological assumptions associated with each, and then states the worldview held by this researcher.

3.2.3.1 Post-positivism

The *post-positivist* worldview, often referred to as the *scientific method,* is also known as positivist/ post-positivist research, empirical science and post-positivism (Creswell, 2009). Ontologically, post-positivists have a tendency to view reality as singular; using a theory to help explain a single reality (Creswell & Plano-Clark, 2011). Within post-positivism, researchers make claims for knowledge based on *determination*, in which the problems studied reflect the need to identify and assess causes influencing outcomes (Creswell, 2009; Creswell & Plano-Clark, 2011). It also advocates *reductionism* in which ideas are reduced into a small, discrete set of ideas to test, such as the variables that comprise hypotheses and research questions. The other claim relates to *empirical* *observation and measurement*, that is, the development of numeric measures of observation (Creswell & Plano-Clark, 2011). The next assertion relates to *theory verification*, and as such theories need to be tested or verified and refined to better understand the world. With regards to the methodological approach, that is, the process of research used in post-positivist research, the researcher works from top-down, and hence works from a theory to hypotheses to data to add to or contradict the theory (Creswell & Plano-Clark, 2011). This is seen as an approach for quantitative research (Creswell, 2009). Some of the key assumptions of post-positivism (Creswell, 2009, p. 7) include:

1. Knowledge is conjectural (and anti-foundational) and the absolute truth can never be found. As such, any evidence established in research is always imperfect and fallible.
2. Research is a process of making claims and then refining or abandoning some of them for other more strongly warranted.
3. Data, evidence, and rational considerations shape knowledge.
4. Research seeks to develop relevant, true statements; ones that can serve to explain the situation of concern or describe the causal relationships of interest.
5. Being objective is an essential aspect of competent inquiry and thus researchers must examine methods and conclusions for bias.

3.2.3.2 Constructivism

The constructivist worldview is often combined with interpretivism, and is typically seen as an approach to qualitative research (Creswell, 2009). In this worldview, the *understanding and meaning* of the phenomena of interest is formed through participants and their subjective views. Participants seek an understanding of the world they live and work in and as such there are *multiple participant meanings* as individuals develop subjective meanings of their experiences (Creswell & Plano-Clark, 2011). As such, the researcher relies on the participants' view of the investigated phenomena, and as such questions posited are broad and open-ended, so that participants can construct the meaning of a situation (Creswell & Plano-Clark, 2011). Furthermore, subjective meanings are formed through interaction with others and through historical and cultural norms that are operational in the participants' lives (Creswell, Plano-Clark, Gutmann, & Hanson, 2003).

With regards to theory generation, researchers inductively develop a theory or pattern of meaning, rather than starting with a theory as in the case of post-positivism. Constructivist contend that the world consists of multiple individual realities and hence they actively seek multiple perspectives from participants, developed through multiple interviews (Creswell & Plano-Clark, 2011). In their research, constructivists tend to use a 'bottom' up approach, whereby the participants views are used to build and develop broader themes and generate a theory that interconnects the themes (Creswell & Plano-Clark, 2011). Some assumptions of constructivism Creswell (2009, p. 8) include:

1. Meanings are constructed by human beings as they engage with the world they are interpreting. Researchers in this context tend to use open-ended questions so that participants can express their views.
2. Humans engage with their world and make sense of it based on their historical and social perspectives. This worldview assumes that we are all born into a world of meaning bestowed upon us by our culture. Hence although researchers seek to understand through the participants' lens, the interpretation of the findings is also inevitably shaped by the researchers' own experiences and backgrounds.
3. The basic generation of meaning is always social, arising in and out of interaction with a human community. Notably, the process is largely inductive and meaning generated from data collected within the field.

3.2.3.3 Participatory worldview

In the *participatory worldview*, researchers advocate an action agenda to help marginalised individuals (Creswell, 2009). This worldview is often associated with a qualitative approach rather a quantitative approach. This group of researchers claim knowledge through advocacy or participatory approach (Creswell, 2009), out of the need to improve society, and hence posit that issues such as empowerment, marginalization, hegemony, patriarchy, etc. affecting marginalized groups must be addressed (Creswell & Plano-Clark, 2011). Some assumptions of the advocacy/ participatory worldview include (Creswell, 2009, p. 10 - 11):

1. Research inquiry needs to be intertwined with a political agenda that results in changing lives of participants and the institutions in which they work.
2. Social issues such as empowerment, inequality, oppression, domination, suppression and alienation need to be addressed.
3. It is change oriented, and hence advocacy research provides a voice for the participants in an effort to improve their lives.

3.2.3.4 Pragmatism

Pragmatism is a 'deconstructive paradigm that debunks concepts such as 'truth' and 'reality' and focuses primarily on "what works" as the truth regarding the *research question under investigation* (Teddlie & Tashakkori, 2003). With pragmatism, the focus is on elements including the consequences of the research, the primary importance of the question asked rather than the methods, and on the use of multiple methods of data collection to inform the problems under the study (Creswell & Plano-Clark, 2011). Ontologically, pragmatists view reality as both singular as well as multiple (Creswell & Plano-Clark, 2011). By singular it suggests that there may be a theory that operates to explain the phenomena of study, however, multiple varied individual inputs can be assessed to investigate the nature of the phenomenon (Creswell & Plano-Clark, 2011). Consequently, pragmatism uses a pluralistic approach to derive knowledge about the problem, and is oriented toward "what works" and practice (Creswell, 2009; Creswell & Plano-Clark, 2011). Some assumptions of the pragmatism worldview (Creswell, 2009, p. 13) include:

1. Pragmatism is not committed to any one system of philosophy and reality.
2. Individual researchers have freedom of choice, and as a result they are 'free' to choose the methods, techniques and procedures that best suit one's needs and purposes.
3. Pragmatists do not see the world as an absolute unity.
4. Truth is what works at the time, and it is not based in a strict dualism between the mind and reality completely independent of the mind.
5. Pragmatist researchers look to the '*what*' and '*how'* to research based on its intended consequences.

A pragmatic stance is adopted for this research. As noted earlier, the main focus and/or consideration of the pragmatic philosophy are the research questions (Creswell & Plano-Clark, 2011; Saunders et al., 2009) (See Chapter 1), which in this context focus on how individuals' use of IS changes over time. A pragmatic stance allows for in-depth findings from qualitative data and generalizable results from the quantitative data to be brought together to understand change in IS use over time. A fundamental principle of the pragmatist position is that the research purpose and its accompanying research questions should guide the delimitation of the objects to study. Using the pragmatic approach, the study allows for a focus on real-world applicable results to understand how post-adoption use evolves within a 'real life' context and offers a 'uniformity of scientific reasoning', which allows qualitative and quantitative methods to exist side-by-side (Howe, 1988).

Drawing on an evolutionary change framework, this research identifies and examines factors that enable and/or inhibit individuals to change how they use an IS to accomplish work tasks. In line with the pragmatic approach, this research employs a mixed method approach, combining qualitative and quantitative, to understand changes in use, valuing both objective and subjective knowledge. The next section will therefore elaborate on the mixed method approach used in this research to investigate changes in post-adoption use.

Table 3.1 Elements of Worldviews and Implications for Practice

Worldview Element	Post-positivism	Constructivism	Participatory	Pragmatism
Ontology (What is the nature of reality?)	Singular reality (e.g. researchers reject or fail to reject hypotheses)	Multiple realities (e.g. researchers provide quotes to illustrate different perspectives)	Political reality (e.g. findings are negotiated with participants)	Singular and multiple realities (e.g. researchers test hypotheses and provide multiple perspectives)
Epistemology (What is the relationship between the researcher and that being researched?)	Distance and impartiality (e.g. researchers objectively collect data on instruments)	Closeness (e.g. researchers visit participants at sites and collect data)	Collaboration (e.g. researchers actively involve participants as collaborators)	Practicality (e.g. researchers collect data by “what works” to address research questions
Axiology (What is the role of values?)	Unbiased (e.g. researchers use checks to eliminate bias)	Biased (e.g. researchers actively talk about their biases and interpretations)	Negotiated (e.g. researchers negotiate their biases with participants)	Multiple stances (e.g. researchers include both biased and unbiased perspective)
Methodology (What is the process of research?)	Deductive (e.g. researchers test an a priori theory)	Inductive (e.g. researchers start with the participants’ views and build “up” to patterns, theories and generalizations)	Participatory (e.g. researchers involve participants in all stages of the research and engage in cyclical reviews of results)	Combining (e.g. researchers collect both quantitative and qualitative data and mix them)
Rhetoric (What is the language of the research?)	Formal style (e.g. researchers use agreed-on definitions of variables)	Informal style (e.g. researchers write in a literary informal style)	Advocacy and change (e.g. researchers use language that will help bring about change and advocate for participants	Formal or informal (e.g. researchers may employ both formal and informal styles of writing)

Source: (Creswell & Plano-Clark, 2011)

3.3 Research Method: Mixed Methods

Having addressed the research paradigm, that is, the ontological and epistemological positions applied in this research, the next stage was to determine the most appropriate research method. A mixed method research design was applied, which is a procedure that collects, analyzes and mixes both quantitative and qualitative methods in a single study to understand a research problem (Creswell, 2007). The basic assumption of mixed method research is that both qualitative and quantitative data, when combined, provides a better understanding of the research problem and questions than either method by itself (Creswell, 2007).

Qualitative data as a research strategy emphasizes words rather than quantification in the collection and analysis of data (Bryman & Bell, 2007). It thus applies methods such as open-ended interviews that provide the actual words of participants, which offers many different perspectives on the investigated phenomena, providing a complex picture of the situation (Creswell, 2007). On the other hand, quantitative research entails the collection of numeric data and shows evidence of the relationship between theory and research as deductive. The quantitative data in turn yield specific numbers that can be statistically analyzed, producing results to assess the frequency and magnitude of trends describing the population (Creswell, 2007).

Certainly there is no shortage of debate about combining qualitative and quantitative, with some arguing that the paradigms are different and incompatible based on their epistemological and ontological assumptions (Creswell, 2010). In the face of such criticisms, proponents of the mixed methods approach argue that the paradigms are independent and can be mixed and matched in various combinations, leading to useful insights (Teddlie & Tashakkori, 2010).

Supporters of mixed method design describe a characteristic of mixed method research known as 'methodological eclecticism' (Teddlie & Tashakkori, 2010). Methodological eclecticism means that practitioners of mixed methods select and then synergistically integrate the most appropriate techniques from a myriad of qualitative, quantitative, and mixed strategies to thoroughly investigate a phenomenon of interest (Teddlie & Tashakkori, 2010). It stems from rejection of the *incompatibility of methods* thesis, which states that it is inappropriate to mix qualitative and quantitative methods because of the fundamental differences between the paradigms supposedly underlying both methods (Teddlie & Tashakkori, 2010).

Advocates of mixed method approaches deny that wedding both methods, qualitative and quantitative, is epistemologically incoherent (Howe, 1988), and thus an enduring and beneficial relationship between qualitative and qualitative methods is possible (Reichardt & Rallis, 1994).

Furthermore, supporters of mixed method research stress that “we are free to combine methods and that we do so by choosing what we believe to be the best tools for answering our questions” (Teddlie & Tashakkori, 2010, p. 9). Furthermore, in linking pragmatism with mixed methods, pragmatism rejects the either/or choices associated with the paradigm battle, while acknowledging “the values of the researcher play a large role in the interpretation of the results” (Tashakkori & Teddlie 2003, p. 713).

The philosophical issues surrounding mixed methods research has continued to receive considerable discussion in the literature (Creswell, 2010). Quantitative researchers advocate ideas and concepts such as deduction and certainty as a requirement for true knowledge, empiricism and rationalism, hypothesis testing, casual explanation, and production of universal knowledge (Johnson & Gray, 2010). On the opposing side, qualitative researchers advocate ideas such as humanism and constructivism, and focuses on human understanding and particularistic knowledge (Johnson & Gray, 2010).

Mixed method researchers attempt to provide an alternative position that synthesizes the important aspects of the different methods, and emphasizes notions such as pluralism, multiple realism, compromise, and integration of theory and practice, multiple sources of evidence, and multiple epistemological standpoints (Johnson & Gray, 2010). Combining both quantitative and qualitative methods offers different types of intelligence about a phenomena, rather than simply fusing the outputs of two approaches of enquiry (Snape & Spencer, 2003). Also, importantly, because each method has its limitations, using multiple methods can address some of the disadvantages of each approach (Creswell et al., 2003). There is also a wide consensus that mixing different types of methods can strengthen a study and produce pragmatic/workable solutions for valued ends (Creswell et al., 2003).

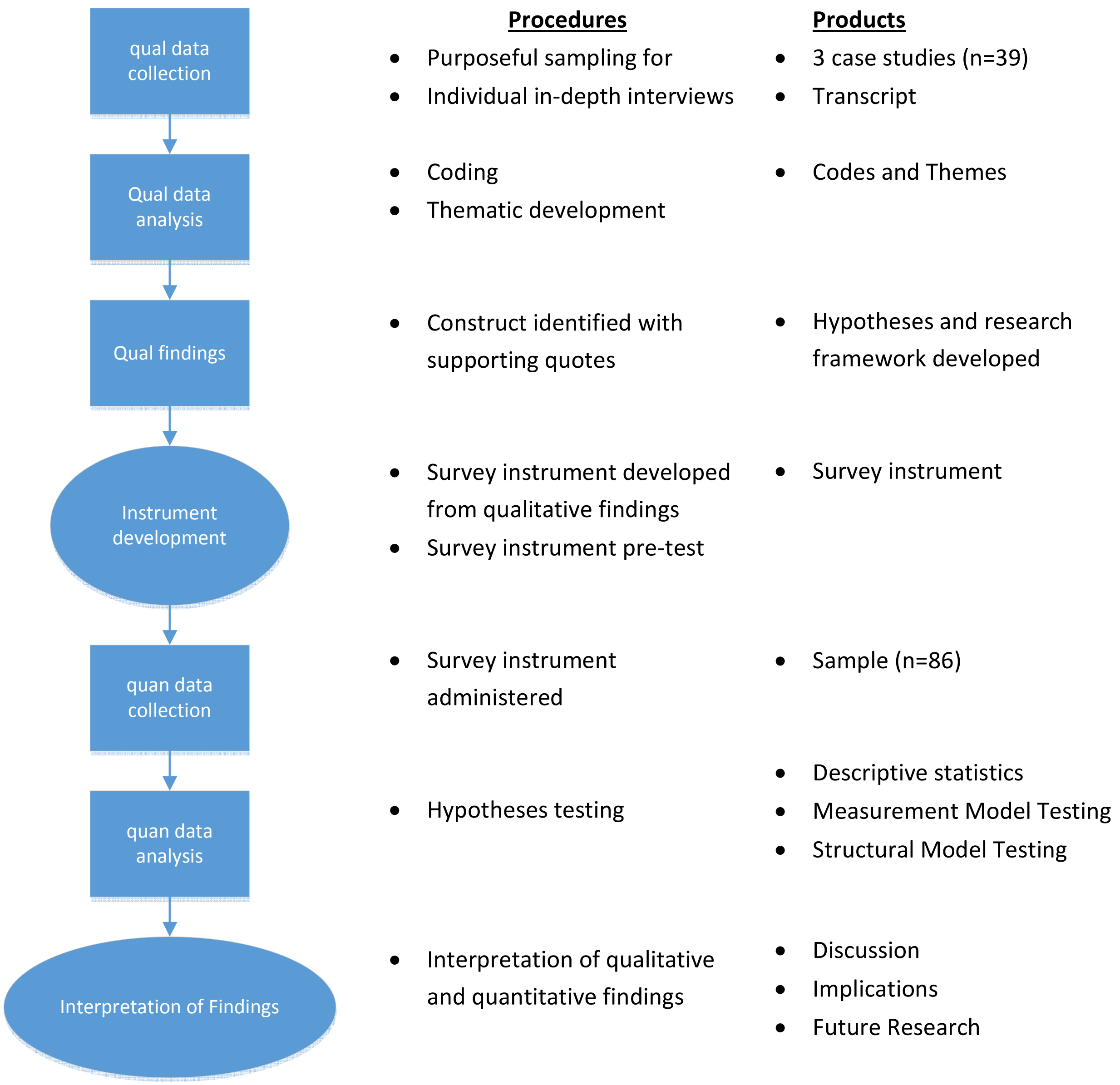
In this research, a mixed method approach was used to provide a greater theoretical and deeper understanding of the changes in post-adoption use. Within the IS field, although there has been calls for methodological pluralism and the benefits of combining multiple methods have been touted, there is a paucity of research in IS that has employed a mixed method approach (Venkatesh, Brown, & Bala, 2013). A review by Ventakesh et al (2013) found that less than five (5) percent of the empirical studies published between 2001 and 2007 (in the six major IS journals from the Senior Scholars' Basket of Journals) have employed mixed methods. The authors concluded, “considering the strength of mixed methods research with respect to understanding and explaining complex organizational and social phenomena, there is clearly a need for IS researchers to conduct and publish research that employs mixed methods” (p.22).

The rational for mixing both methods in this research, is that neither qualitative nor quantitative approach by themselves is sufficient to capture the details of change in use behaviours. As highlighted in Chapter 2, there is a dearth of research on changes in post-adoption use. Furthermore with regards to the enablers, triggers and inhibitors there have been calls for researchers to consider alternative factors that may play a role in post-adoption stage, as opposed to rehashing those identified in research on early adoption or shallow use (Chin & Marcolin, 2001; Jasperson et al., 2005). This research holds that both the quantitative and quantitative method will provide a “very powerful mix” (Miles & Huberman, 1994, p. 42) and a more complete picture of the research problem (Tashakkori & Teddlie, 1998). By using both methods in a single study, it is anticipated that the research will develop a deeper understanding of changes in post-adoptive use and generate new theoretical insights.

This study therefore used a sequential exploratory mixed method design, with two distinct phases. In the design, the qualitative data is collected and analysed first; the results are then used to determine and define the parameters of the data collection for the quantitative phase. The quantitative data is then collected and analysed and the results used to confirm and extend the qualitative results obtained in the qualitative phase.

The qualitative data therefore helped the researcher to understand how individuals’ use of IS changed over time, and the surrounding enablers, triggers, inhibitors and consequences. The qualitative aspect uncovered themes that may not have emerged otherwise without direct contact with users (via interviews), providing value through detailed contextualized information obtained by exploring participants’ views regarding their change in use. The nature of the research problem (i.e. how IS use evolves over time), like most organisational phenomena is quite complex, and thus responses to inquiries about change in use were generally expected to be personally interpretive, subjective, context and role sensitive, relatively unstructured, and rich in their content (Miles & Huberman, 1994). The quantitative data and results on the other hand provided a more generalizable picture of changes in IS use, and helped identify the potential predictive power of the factors enabling change and the outcomes of such change. In essence, the qualitative study was used to identify key themes and their relationship to change, thus enabling the development of a theoretical framework for testing in the quantitative phase, which then provided further insights on changes in use. Figure 3.1 provides a visual model of mixed methods design used in this research.

Figure 3.1 Visual Model for Mixed Method Sequential Exploratory Design Procedures



3.4 Research Approach

There are two main research approaches: deduction and induction (Saunders et al., 2009). Deduction starts with a theory and a hypothesis (or hypotheses), and a research strategy is designed to test the hypothesis. On the other hand, with induction, data is collected and a theory is developed from the findings (Saunders et al., 2009). In determining whether one's research should use the deductive or inductive, it is important to consider the nature of the research topic. If there is a wealth of literature on the topic in order to define a theoretical framework and hypotheses, then the research lends itself more readily to deduction (Saunders et al., 2009). In contrast, if research into the topic is new and there is little existing literature, then the best approach may be to inductively generate data and analyze and reflect on the theoretical themes that emerge (Saunders et al., 2009).

Considering the research questions, the objective of this research and the paucity of research on post-adoption use, both inductive and deductive approaches are useful in order to provide answers and give meaning to the outcomes of this study. This is because this study aims to understand how changes in IS use evolves over time in order to develop theory and subsequent propositions (and then hypotheses) about the change process. This research uses a mix of a prior and 'new' theory, with the latter emerging from inductive analyses.

Combining both approaches within the same research is often advantageous as it provides useful insights into the phenomena of interest (Saunders et al., 2009). This combined approach is in line with a pragmatic philosophical perspective, as the research question(s) remain the central guide to the approaches described in this section. In the following section, the detailed design for the qualitative and quantitative phases is presented and discussed.

3.5 Qualitative Phase

3.5.1 Case Study Research

A multiple case study design (Yin, 2008) was used for collecting and analysing data in the qualitative phase. Case studies are a strategy of inquiry in which the researcher explores in depth a program, event, activity, process, or one or more individuals (Creswell, 2008). Each case study was bounded by selected users in three (3) organizations to gain insight on the process of changes in post-adoptive use within a 'real life' context. According to Yin (2008), a case study design should be considered when the focus of the study is to answer 'how' and 'why' questions; when the investigator cannot manipulate the behaviour of those involved in the study and to understand contextual conditions as it is relevant to the phenomenon under study. The case study approach as a research strategy focuses on understanding the dynamics present within single settings and are instrumental when considering building theoretical models (Eisenhardt, 1989).

Case studies in IS research is a viable strategy for this study for several reasons. First, it allows the researcher to study the IS in a natural setting, to learn about the IS itself and to generate theories from practice (Benbasat, Goldstein, & Mead, 1987). Second, as Benbasat et al (1987) argued, through case studies researchers can gain a better understanding of the nature and complexity of the processes occurring in organizations. This lends itself to another objective of this study, which is to explain how changes in post-adoption IS use comes about. Third, with the field of IS changing rapidly, valuable insights can be gained through the use of case study research (Benbasat et al., 1987). Further support for the use of case studies in IS research, can be found in arguments by Oates (2005) who noted that such a strategy is particularly suited to research into the development, implementation and on-going use of IS as it enables researchers to study the factors and their inter-relationships (such as between managers, users, technology, etc.).

By applying a case study strategy, it is anticipated that this research will provide a rich understanding of the context of post-adoption use and the underlying process. This strategy seemed the most appropriate for the research questions put forward in this study, which seek to understand 'how' use evolves over time and hence, this type of question is best suited for the case study strategy. Although case study research is not generalizable to large populations, it can be used to generalize to theoretical propositions (Yin, 2008), which can be tested further, for example, quantitatively, as was done in this research.

3.5.2 Case Selection

Purposeful sampling (Miles & Huberman, 1994) was used to select participating organizations, the focal system and subsequently the users that were interviewed. Multiple cases increase the methodological rigor of the study through "strengthening the precision, the validity and stability of the findings" (Miles & Huberman, 1994, p. 29). This is so because "evidence from multiple cases is often considered more compelling" (Yin, 1994, p. 45), and enables the generation of theory (Eisenhardt, 1989; Yin, 1994).

This research focused on use of Complex Information Systems in large firms in New Zealand. Complex Information Systems (CIS) refers to large organizational Information Systems that integrate and streamline business processes across functional departments/areas (Hsieh and Wang, 2007). Organizations invest heavily in Information Systems and since they are typically adopted at the organizational level, employees are often obligated to use the adopted system (Wang and Hsieh, 2006). The complexity and flexibility of these CIS often allow employees to choose how they use or infuse the System at different levels of sophistication. However, evidence suggests that the functional potential of these applications are often underutilized, with users applying only a limited number of available features or seldom apply task-related features to relevant operations (Hsieh and Wang, 2007). Coupled with the malleability of CIS, this makes CIS ideal candidates (context) for exploring differences and consequently change over time in how individuals use an IS for their work. In short, Complex Information Systems (e.g. ERP, CRM systems) were targeted in this study as these afford good opportunities for use to vary.

There are no specific guidelines and/or information available in the extant literature on the average time needed to attain routine use of a complex IS (such as ERP) (Hsieh & Wang, 2007). However, drawing insights from another study, Hsieh and Wang (2005) noted that the findings revealed that fifteen (15) months after implementation, an ERP system installed in an organization was still not being used to its full potential. Based on such, they deduced that a two (2)-year implementation span is appropriate for capturing deeper types of use. This was used as a guide in selecting participating organizations in this research, such that the selected system (including earlier versions of the IS) needed to have been in place for a reasonable period, e.g. two (2) years, to give time for users to infuse the IS into their work practices.

As noted earlier, purposeful sampling was further used to select individuals to participate in the interviews on changes in use (Miles and Huberman, 1994). The literature on end-user computing presupposes that individuals will differ in the way they use and apply the features of the IS over time (Munro et al., 1997). In order to get a cross-section of users, interviews were conducted with basic, intermediate and advanced users. By capturing data from different user types (i.e. ranging from basic to advanced users), this also allowed the research to capture varying perspectives on different stages of the ‘journey’ regarding how their use had changed (or not) over time.

Definitions for each user category were adapted from Munro et al. (1997) and provided to organizational contacts to identify participants. The operational definition for each group, relative to their job role was given as follows:

- Basic: Individual users who use a narrow set of IS features in performing work tasks.
- Intermediate: Users who have mastered the full capabilities of IS (relative to their jobs/roles) and are able to apply the IS features to leverage work tasks.
- Power/Advanced/Innovative User: Users who have more than an encyclopaedic grasp of the features and capabilities of the IS; the user has the ability to exercise innovativeness and creativity in the practical use of the technology - the ability to find new or unusual,

especially effective ways of using a technology that were seen as innovative in the organization; in effect, 'pushing the boundaries of the IS.'

3.5.3 Data Collection: Interviews

There a number of sources of evidence that can be used within a case study research methodology, such as documentation, archival records, interviews, direct observations, participant observation, and physical artifacts (Yin, 2008). Table 3.2 outlines the strengths and weaknesses of each of these aforementioned sources of evidence as described by Yin (2008)

Interviews were the primary data collection method used for the qualitative aspect of this research. Interviews are an effective data source in understanding the social context, as they afford the researcher the "best access to the interpretations that participants have regarding the actions and events which have taken, or are taking, place, and the views and aspirations of themselves and other participants" (Walsham, 1995, p. 78). The interview questions were open ended in nature and were used to guide the conversation; rather than impose a consistent line of enquiry, questions were fluid rather than rigid (Yin, 2008).

With this exploratory approach, the meanings and rich descriptions from users proved to be of value, "not merely because they reveal subjects' states of mind which can be correlated with external behaviours, but because they are constitutive of those behaviours" (Orlikowski & Baroudi, 1991, p. 13). As a consequence, the interview was an essential source of information, and a useful technique for discovering dimensions of post-adoptive use from which concepts, themes, and patterns emerged that were ultimately used to develop a theoretical framework.

Mindfully, as noted by Yin (2008) in Table 3.2, using interviews as a source has its shortcomings, which include question bias, recall bias, poor recall (that can lead to inaccuracies) and reflexivity. The next section discusses the techniques used in the interviews and also highlights how the shortcomings (of interviews) were minimized.

Table 3.2 Six Sources of Evidence: Strengths and Weaknesses

Source of Evidence	Strength	Weaknesses
Documentation	• Stable- can be reviewed repeatedly • Unobtrusive- not created as a result of the case study • Exact- contains exact names, references, and details on an event • Broad coverage- long span of time, many events and many settings	• Retrievability- can be difficult to find • Biased selectively, if collection is incomplete • Reporting bias- reflects (unknown) bias of author • Access- may be deliberately withheld
Archival records	• [Same as those for documentation] • Precise and usually quantitative	• [Same as those for documentation] • Accessibility due to privacy reasons
Interviews	• Targeted- focuses directly on case study topics • Insightful- provides perceived casual inferences and explanations	• Bias due to poorly articulated questions • Response bias • Inaccuracies due to poor recall • Reflexivity-interviewee gives what the interviewer wants to hear
Direct observation	• Reality - covers events in real time • Contextual - covers context of a 'case'	• Time consuming • Selectivity- broad coverage difficult without a team of observers • Reflexivity- event may proceed differently because it is being observed • Cost- hours needed by human observers
Participant-observation	• [Same as those for direct observations] • Insightful into interpersonal behaviour and motives	• Same as those for direct observations] • Bias due to participant-observer's manipulation of events
Physical artifacts	• Insightful into cultural features • Insightful into technical operations	• Selectivity • Availability

Source. Yin (2008)

3.5.4 Organise and conduct interviews

Five (5) organizations, through the Chief Information Officer (CIO) were initially contacted to partake in the research by accommodating interviews with users of their IS. Three (3) organizations showed a high level of interest in the research project. An initial meeting was kept with the CIO (or equivalent) of the three (3) organizations to provide further information on the research and also to outline level of support and involvement that was required by the firm. See Appendix B for the Information Sheet.

After all three (3) firms confirmed their willingness to participate, the CIO helped in identifying a suitable IS system for the research, and provided background details on the implemented IS. Also, where possible, trainers were interviewed (in 2 of the 3 firms) to get a greater appreciation of the IS (which included a demo of the IS) and to gain further insights on how individuals in the firm use the IS.

Moving forward, the CIO for each firm assigned two organization contact persons (a senior manager and an administrative staff) who helped with the arrangements, which included identifying and contacting potential participants, and scheduling meeting times and rooms. For each organization, an initial request was made for ten (10) interviewees, including at least three (3) basic, intermediate and advanced users. Eisenhardt (1989 p. 545) writes of "theoretical saturation…the point at which incremental learning is minimal because the researchers are observing phenomena seen before." For each firm, saturation was reached at different points. The following paragraphs summarizes information on each firm, including the IS and number of interviewees. Further information on findings is provided in the Chapter 4.

3.5.4.1 Case Studies

Data was collected from three (3) large organizations in New Zealand representing a diverse range of industries and IS; these three (3) firms will be referred to in this dissertation as - AgriCo, CommCo, and EnergyCo. The selected IS in each firm was a Complex Information System with a wide range of features, as the malleability of such systems make them ideal candidates for exploring change in individuals' use of IS. AgriCo is one of the largest suppliers of fertilizer products, and uses a *Customer Relationship Management System* (CRM) to manage their customer base and help improve the quality of service provided to clients. CommCo focuses on radio communications, providing computerized data and voice communication products and services, including an automated fleet management system and mobile data solutions for the transportation industry. They currently use a *Collaboration System* to support communications, document sharing and management, and other forms of collaborative work. Lastly, EnergyCo is a large energy generator, and uses an *Information Technology Service Management* (ITSM) system to integrate and automate service management and quality control of the IT services that the firm depends on.

At AgriCo, 19 users were interviewed - 3 basic, 7 intermediate, and 9 advanced users. At CommCo, 11 users were interviewed: 2 basic, 5 intermediate, and 4 advanced users. At EnergyCo, 9 users were interviewed: 3 basic, 2 intermediate, and 4 advanced users. In total 39 users were interviewed.

On average, each interview lasted about one hour and was digitally recorded. It was downloaded as an audio file and the content transcribed directly from the audio record to a Word document. This was done immediately following the interview in order to capture and follow-up on anything that may not be completely clear, while the interview was still 'fresh' for both the interviewee and the researcher. This was also intended to address the third weakness of the interview process, identified by Yin (1994), namely 'inaccuracies due to poor recall'. The transcribed interviews each generated between 15 and 22 pages of text of conversations. The transcriptions were then ready for analysis, consideration of the findings drawn from the analysis, and subsequent theory building.

3.5.5 Interviewing Technique: Critical Incident Technique

For the user interviews, the Critical Incident Technique (CIT) was used to guide the data collection, as it facilitates the investigation of significant occurrences (e.g. events, incidents, processes) identified by the respondent, the way they are managed, and the outcomes (Flanagan, 1954).

The term *critical incident* comes from the Critical Incident Technique, a qualitative procedure originally developed by Flanagan (1954). Flanagan writes that a critical incident is:

> *"By an incident is meant any observable human activity that is sufficiently complete in itself to permit inferences and predictions to be made about the person performing the act. To be critical, an incident must occur in a situation where the purpose or intent of the act seems fairly clear to the observer and where its consequences are sufficiently definite to leave little doubt concerning its effect"* (Flanagan, 1954, p. 327).

Flanagan (1954) first described this technique as a set of procedures for collecting direct observations of human behaviour to facilitate their potential usefulness in solving practical problems, and thereby to develop broad psychological principles. He further notes:

> *"The essence of the technique is that only simple types of judgments are required of the observer, reports from only qualified observers are included, and all observations are evaluated by the observer in terms of an agreed upon statement of the purpose of the activity." (p. 335)*

A condition of the Critical Incident Technique (CIT) approach to data collection is that the behaviours or results observed should be evaluated, classified, and recorded while all the facts about an incident are fresh in the observers' (respondent) mind and, ideally, can be checked (Flanagan, 1954). However CIT is often used to gather data on observations made at an earlier time and reported from memory, as was the case in this research. This is acceptable because evidence regarding the accuracy of reporting is usually contained in the incidents themselves (Flanagan, 1954), that is, "if full and precise details are given, it can usually be assumed that this information is accurate. Vague reports suggest that the incident is not well remembered and that some of the data may be incorrect" (p. 340).

Flanagan (1954) argued that CIT interviews are "somewhat different" from other types of interviews and described key principles involved that the interview should adhere to. These are discussed below:

- *Specify the sponsorship of the study:* At the beginning of the interviews, I introduced myself and stated my course of study. It was made clear to the interviewees that the University of Canterbury and also the management of the participating firm supports the research.
- *State the purpose of the study.* At the start of each interview, I reminded interviewees of the purpose of the study, that is, to understand change in IS use over time. This was also outlined in the information sheet, which they received prior to the interview (See Appendix C).
- *Help the subject feel part of the group.* To ensure that individuals felt comfortable, as suggested by Flanagan (1954), I addressed the 'But, why ask me' question at the start of the interviews. Thus interviewees were informed that their input is valuable to understand how changes (or not) occur over time, and that the perspectives of different types of users (ranging from basic through to intermediate and advanced) would be invaluable for gaining a good (and more complete) understanding changes in IS use. This approach was especially useful for encouraging basic users to participate as they often (at the start of the interview) felt that they had little to offer regarding the research topic).
- *Speak to the anonymity of the data.* The key task here is to assure the interviewees and the participating firm that their identity will be protected. According to Flanagan (1954), the best way

to do that is to explain all the precautions being taken to safeguard anonymity. I addressed the issue of anonymity in the consent form (See Appendix D), and at the beginning of the interview.

- *Craft the questions carefully.* Flanagan (1954) called this the most crucial aspect of the data collection procedure and insisted that even a slight change in wording may produce a substantial change in the incidents reported. He recommended developing the questions, trying them out "on a small group of typical observers," asking persons to state in their own words what they understand they have been asked to do before actually using the questions in the study (p. 341). In this study, the first draft of the interview questions was critiqued by academics for length, structure, completeness, and clarity. Ten (10) pilot interviews were conducted, and the questions were refined with various iterations of the interview guide evaluated for timing, structure, flow, and interviewee acceptability and accuracy. The final version of the interview guide is given in Appendix E.
- *Limit bias by keeping the conversation "neutral and permissive."* For Flanagan (1954), "neutral and permissive" means letting observers talk and showing acceptance for what they are saying (p. 342). If parts of the story seem to be missing, he suggested restating the essence of the remarks, which usually encourages observers to continue and may help them remember relevant details. In this research, this was done by restating and/or summarizing what the interviewer said, which at times prompted the user to continue on with the story and/or provide clarification.

In summary, this study used Critical Incident Technique as the major technique to elucidate changes in post-adoption IS use. The first few questions were designed to get some background on the interviewee such as current job position, length of time in firm, etc. and also to serve as an icebreaker for the interview. For the user interviews, the Critical Incident Technique (CIT) was used to guide the data collection, as it facilitates the investigation of significant occurrences (e.g. events, incidents, processes) identified by the respondent, the way they are managed, and the outcomes (Flanagan, 1954). Users were asked to relate incidents or events that describe changes from their initial use to their current use. As respondents related their 'journey' of how their use had changed (or not) over time, probing questions were asked to understand the 'how' and 'why' of such changes.

3.5.6 The Coding Process

Data analysis is defined as the process of "examining, categorizing, tabulating or otherwise recombining the evidence" (Yin, 1994, p. 102). This section describes the Miles and Huberman (1994) and Miles, Huberman and Saldana (2013) model used for the analysis of the interview data in this research. It consists of three (3) concurrent flows of activities: data condensation/reduction, data display and data conclusion-drawing/verifying. The process was applied to each interview as it came in, that is, each interview was coded and added to what was already collected. Checks and crosschecks were done to ensure themes were captured accurately, and re-coding of concepts carried out where appropriate as new insights were gained and concepts were clarified further over the course of the collection and coding process.

Data Condensation[3]/Reduction

Data condensation refers to the process of choosing, focusing, simplifying, building and transforming data in the interview transcripts (Miles & Huberman, 1994; Miles, Huberman, & Saldana, 2013). The data from the interviews were analyzed initially through a process of data reduction/condensation (Miles & Huberman, 1994). In this research, the data condensation process was as follows: the majority of the data was collected by in-depth interviews, each lasting approximately one (1) hour. Each interview was audio recorded and composed on average 14-20 pages of text each. The researcher then read through the text. The data condensation phase involved highlighting segments from each participant's full text transcript that could be used to answer the research questions and/or address the research objectives.

As a major element of this phase, the data was broken down into discrete components, examined, and similar data were grouped into categories or codes (Strauss & Corbin, 1998). The initial coding begun with line-by-line coding (Charmaz, 2006) and as the process continued for each case, the categories was further reduced into subcategories (Creswell, 2008). As such, the highlighted segments were broken down into smaller segments and/or themes. After establishing the first set of themes, the full content was read through again to compare, contrast and search for missing information that did not appear in the first level of themes. The data was read through multiple times before and after identifying the themes and codes in order to fully appreciate the full picture of the participants' story. A tabulation of the emerging themes was done in a Word document. Appendix F

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[3] The first stage was initially called 'data reduction' by Miles and Huberman (1994), however it was renamed 'data condensation' by Miles, Huberman and Saldana (2013) as they argued that data reduction as a term implies that "we're weakening or loosing something in the process" (p. 12)

shows the coding scheme that was used and examples of text segments for each code. Finally, the process continued with a cross-case comparison during which the themes and dimensions were further analyzed.

Data condensation/reduction allowed the researcher to sharpen, sort, focus, discard and organize data in such a way that some level of conclusion could be drawn. The coding scheme shown in Appendix F was therefore further reduced to yield the overarching categories, identified in Appendix G. These were coded to identify information that relates to the research questions (Section 1.3). Thus segments of text were sought that reflected (a) the process of change, by way of variation, selection and retention; (b) the factors that play a role in facilitating variation, selection and retention, and (c) the outcome of change.

The knowledge of theoretical terms from the literature by way of Generalized Darwinism (variation, selection and retention) aided in the coding process for accurate representation of the data. The use of multiple coders to increase coding reliability was not used in this study for two key reasons. First, this technique requires each coder to have extremely similar theoretical sensitivity (Glaser, 1978). Second and more importantly, technical knowledge about each System under discussion was necessary to understand and code some aspects of the transcripts. Knowledge of the context and technicalities of the System was therefore instrumental in understanding the participants' story as they described their changes in use over time, and as they provided specific examples of change. To aid understanding, the researcher received a walk-through of each IS, including 2-3 hours training on the respective Systems from IS personnel, and was given access to documentation on the IS, so had referent knowledge that was not available to a second coder. Together, these two factors made it difficult to use a second coder with accuracy.

Although the use of multiple coders offers advantages, for this case study it was arguably more reliable and feasible to ensure that the single coder was provided with a period of training before setting about the task of coding the full data set (Milne & Adler, 1999). For this study, the single coder (this researcher) underwent a period of training facilitated by the pilot interviews, which had a sample of 10 users. The senior supervisor who was familiar with the context and technology used for the pilot also examined the reliability of the coding decisions on the pilot sample and where necessary adjustments were made to assure agreement on the reliability of the coding decisions.

Furthermore, to combat the issues that may have arisen from not having multiple coders, expert advice was further sought from the dissertation supervisors who were familiar with the literature applied in this research to enhance theoretical sensitivity. Joint periodic reviews of selected transcripts and coding outputs were conducted with this researcher and the supervisors to ensure that subtleties in the data were not overlooked or coded at a level that overlooked key themes, and to ensure face validity of the concepts, categories, and codes (Abraham, Boudreau, Junglas, & Watson, 2013; Abraham, 2004).

Data Display

The second step of the Miles and Huberman Model (1994) and Miles, Huberman and Saldana (2013) is data display, where information is displayed, organized, compressed, and assembled to allow a conclusion to be drawn. As noted by Miles and Huberman (1994), data display is not separate from the data reduction, as the latter complements the former. Following data reduction/condensation (See Appendix F), the researcher reviewed the research questions to further identify any information that relates to similar concepts.

For this research, the data was displayed using tables. The tables were used to map the relationships between certain behaviors and the associated factors. A sample table is presented in Appendix H, which was used to assemble and systematize the information from the interviews, and map the relationships. By using direct quotes, it provides supportive meaning to the data's interpretation for some statements (Patton, 2002). Also, differences, similarities and interrelationships within and across the cases were examined; an example of the outputs is presented in Table 4.1 in Chapter 4 in the cross-case analysis section.

Conclusion drawing and verification

This step, conclusion drawing or verification, entails the interpretation phase where meaning and sense is given to the analyzed data by way of searing for descriptive pattern in the data. During this activity the researcher sought to find certain regularities, patterns, explanations, possible configurations, causal flows, and propositions (Miles & Huberman, 1994). Conclusions were drawn from data reduction and data display, to create a coherent story, with the conclusions linked to the research questions (Miles & Huberman, 1994).

This process was like a big jigsaw puzzle being assembled without a picture to guide the process. In the final phase, the task was like "the completion of a jigsaw puzzle", where "the finished puzzle represents the results of our research, and through it we can identify different facets…" (Dey, 2003, p. 41). Some of these 'jigsaw pieces' helped in building a theoretical framework geared at understanding changes in IS use. In essence, some clear, identifiable concepts or themes arose out of the qualitative data being brought together in the most logical manner. In the end, all the pieces had to fit, and make sense, for the subsequent theory to appear and be credible. The final model was used to inform the research model that was then tested in the quantitative phase.

3.5.7 Validity, Relevance and Reliability

It is important that a research study demonstrate validity and reliability so as to offer a sound basis, upon which future research can build (Yin, 2009). Yin (2009) posits four (4) criteria that can be used to judge the quality of qualitative research: *construct validity, internal validity, external validity, and reliability*. These will be discussed below along with how this study sought to address each criterion.

Construct validity in case study research is challenging (Yin, 2009). In qualitative research, construct validity seeks to identify correct operational measures for the concepts being studied (Yin, 2009). In this study the 'constructs' of interest include variation, selection and retention, that is, in relation to Generalized Darwinism. Yin (2009) offers three (3) recommendations for achieving construct validity in case study research: use of multiple sources of evidence (also called data triangulation), establishing a chain of evidence, and having key informants review draft case study reports.

In this study, triangulation was achieved by involving multiple respondents within a single organization, that is, for each firm, users, the Chief Information Officer (or representative), an IS person and/or the System trainer were interviewed. Triangulation was further achieved by using multiple sources of evidence, for example, observation and document reviews. In all three (3) organizations, the researcher had a walkthrough of the System with the trainer and/or an IS support person, which enabled the researcher to better understand the context and the interview details that often included technical content as users described how they used the Systems and various features to support different tasks. Also, for this study, where possible, a summary of findings was also sent to the participating firm with opportunities for further discussion. It is anticipated that these techniques will provide support for the results, and minimize the likelihood of erroneous viewpoints arising from the primary use of a single researcher during data collection and coding.

Internal validity is concerned with establishing a causal relationship between constructs (Yin, 2009). For this study, the researcher sought to explain how and why change in use occurred and the outcome. To investigate that relationship, an analysis of the participant interview data was performed to identify specific statements linking change and the causes, along with change and consequent use. For example, when change was described, interviewees were also asked to explain how the change came about and the consequence of such change, allowing for a direct link between concepts to be established.

External validity is concerned with the generalizability of the study's findings beyond the immediate case study, that is, to larger population (Yin, 2009). In case study research, even with 39 users across 3 organizations, this type of generalizability is not possible. Instead, the findings are presented in a manner that allows the reader to assess their potential applicability to other settings (Miles & Huberman, 1994). To assist this process, a detailed description of each organization and IS investigated is provided, so as to allow the reader to understand the context in which the users operate, which can aid the reader in deciding the applicability of the findings to other contexts. According to Yin (2009), replication logic can also be used to address external validity. In this study, the IS used across the three (3) organizations (from which user/participants were selected) were large scale complex IS which were malleable enough to allow users to change how they used the system to support their work. Although the organizations were different and the jobs and users involved were different, it was expected that the general principles of change could still apply and so be uncovered for each case, even if the enactment details and enablers differed to some extent for each organization and across users. Hence, it was anticipated that largely similar results would arise.

Reliability refers to the extent to which the study's operations can be repeated with the same results (Stuart, McCutcheon, Handfield, McLachlin, & Samson, 2002). Yin (2009) recommends that a study's reliability can be enhanced in two ways: through the case study protocol and the case study database. The case protocol was described in this chapter and included the participant information sheet, consent forms (for organization and individual), interview schedule. The same protocol was used for all 3 organizations to assure reliability through replication. Also, an electronic case database was maintained throughout the research process and whenever possible hard copy documents were converted to electronic form and stored. All records pertaining to each case were stored in organized folders for ease of search.

As it relates to rigor, Dubé and Paré (2003) put forward a comprehensive list of practices, drawn from the qualitative literature, that researchers can use to achieve rigor and address validity in case study research in Information Systems. Table 3.3 outlines how this study addressed the relevant attributes (for exploratory studies) outlined by Dubé and Paré (2003). The table is divided into three (3) sections, showing how this study sought to achieve rigor in the research design, data collection, and data analysis.

Table 3.3. Rigor and Validity of the Case Study

Attribute	**How it is used and/or met in this study**
A. Research Design	
Clear research questions	- This dissertation provided details on the specific focus of the study and the potential theoretical and practical contribution. - Two research questions were clearly outlined in Chapter 1
A priori specification of constructs	Generalized Darwinism was put forward as an overarching framework to analyze change in use. This theory identified three (3) constructs- Variation, Selection and Retention, however context-relevant concepts that enabled variations, selection and retention were not specified apriori but were allowed to emerge from the case study data.
Clean theoretical slate	- Generalized Darwinism provided a meta-theoretical structure of overarching principles (that is, variation, selection and retention) at a high-level. The details of how these principles might be enacted, if at all, were not specified apriori in relation to IS use.
Multiple case design	- 39 users across 3 organizations was used in this study
Replication logic in multiple case design	- Three (3) replication cases were conducted, meaning that all 3 organizations had enterprise wide complex IS, which permitted various levels of use and change in use to occur. Participants' use of these systems over time, and thus their change in use was investigated across all 3 firms.
Unit of analysis	- The unit of the analysis is the user of the IS.
Pilot case	- A pilot case study was conducted to refine the interview schedule and test the data collection, coding and validation process.
Context of the case study	- Details were provided for each organization and the IS investigated
B. Data Collection	
Elucidation of the data collection process	- The methodology chapter (Chapter 3) described the data collection procedures and the various sources that contributed to the findings.
Multiple data collection methods	- Multiple data sources were used. These included individual interviews (users, CIO, IS Personnel and/or Trainer), notes recorded during interviews, review of organizational documents, training and observation, etc.
Mix of qualitative and quantitative data	- This study relied on qualitative data to provide insights on change in IS use. Rather than reduce the qualitative findings to quantitative representations, the richness of each participant's story was preserved. For example, the importance of key elements was determined first and foremost by the role they played in determining how a person used the System, and how this changed over time, and not by how often the element was mentioned across the interviews, though this occurrence was not disregarded.

Data triangulation	- Transcripts of interviews for each individual from each group of users (basic, intermediate and advanced) were analyzed.
Case study protocol	- The case study protocol includes the following documents: • Information Sheet for Chief Information Officer • Information Sheet for Interviewees • Consent form • Interview Schedule
Case study database	- Data related to the cases are stored both electronically as well as in hard copy, in an easily searchable form.
C. Data Analysis	
Elucidation of the data analysis process	- The data analysis process is fully described in the methodology chapter (Chapter 3)
Field notes	- Field notes were taken down during the interview where possible and completed shortly after the interviews.
Coding and reliability check	- Using Microsoft Word, sentences were highlighted and tables were used to categorize source data into concepts - Joint periodic reviews of selected transcripts and coding outputs were conducted by the researcher and supervisory team.
Data displays	- Tables were used to display supporting quotes for coded themes and the relationships.
Logical chain of evidence	- The case findings provided details with relevant information (on the organization, participants and IS) so that the reader can follow the derivation of evidence from initial questions to ultimate conclusions.
Searching for cross-case patterns	- Cross-case analysis was used to compare the findings across the cases after identifying categories in the within-case analysis
Quotes (evidence)	- Quotes are available and presented to serve as evidence which can allow the reader to reach an independent judgment regarding the merits of the analysis
Comparison with extant literature	- The findings from the case studies were later compared with the extant literature.

3.6 Quantitative Phase

For the quantitative phase, findings from the case studies together with key theories were used to frame the research model for further analysis. In many cases, previously validated scales were adapted to measure key variables, while some measures were self-developed, such as those for variation and retention, as no suitable or prior measures were found. The model was then tested using data from a field survey and analysed using the PLS approach to structural equation modelling to gain further insights on changes in use. The use of a survey as a technique offers benefits such as the ability to generalize about a population by drawing inferences based on data drawn from a small portion of that population (Rea & Parker, 2012).

A prerequisite to sample selection is to define the target population as narrowly as possible (Salant & Dillman, 1994). Hence, it is important to have a precise and unequivocal definition of the population from which the sample will be drawn (Wolff, 2000). However, since it often not possible to know the true population, a theoretical sample may be used. With theoretical samples, one can purposively select organizations that exhibit the desired features that are the focus of the study (Attewell & Rule, 1991). The same selection criteria discussed in Phase 1, also applied to the quantitative phase, with regards to the size of the organization and the nature of the system, and the types of users surveyed.

Further details on the methodology and instrument design for the quantitative phase is presented in Section 6.2 (Chapter 6).

3.6.1 Measurement Issues

This research sought to develop reliable and valid measures of the constructs that underpin the research model that explains change in IS use. To validate the measurement model, it is important to first assess the reliability and validity.

Reliability is a statement about measurement accuracy, in particular, the extent to which an instrument produces consistent or error free results (Boudreau, Gefen, & Straub, 2001). It speaks to the stability of individual measures across replications from the same source of information (Straub, 1989). It is argued that a measure is reliable when it produces consistent outcomes under consistent conditions (Hair, Hult, Ringle, & Sarstedt, 2013). There are generally five recognised techniques used to assess reliability: internal consistency, split halves, test-retest, alternative or equivalent forms, and lastly inter-rater reliability (Boudreau et al., 2001). The most commonly used measure of reliability however is internal consistency reliability, which will be used in this research (Hair et al., 2013).

Composite reliability is a measure of internal consistency reliability. As a general rule of thumb for model evaluation, the composite reliability of all constructs should be 0.70 or higher (Chin, 2010), which indicates the constructs are within accepted limits and reliable.

Construct validity is defined as the extent to which a construct's indicators jointly measure what it purports to measure (Hair et al., 2013; Straub, 1989), that is, whether it is an effective measure of a theoretical construct (Gefen, Straub, & Boudreau, 2000). Validity is an important element because theoretical constructs are not observable, thus measures of validity show how well a measure reflects its unobservable construct (Ping Jr, 2004). Convergent, discriminant, and nomological validity are considered to be components of construct validity (Straub, Boudreau, & Gefen, 2004). For this research, all three (3) types of validity are examined.

Convergent validity refers to the extent to which a measure correlates positively with alternative measures of the same construct (Hair et al., 2013). It determines the extent to which blocks of items converge (i.e. strongly agree) in their representation of the underlying construct they purport to measure (Chin, 2010). A common measure used to establish convergent validity at the construct level is the average variance extracted (AVE) (Chin, 2010), which is defined as the grand mean value of the square loadings of the indicators related to the construct (Hair et al., 2013). It is a generally acceptable rule of thumb than an AVE value of 0.50 or higher indicates that, on average, the construct explains more than half of the variance of its indicators (Fornell & Larcker, 1981). It should be noted that if the measures are mixed and have a wide range (such as varying from 0.50 to 0.90), it could raise concerns about whether the measures are truly a homogenous set that primarily captures the phenomenon of interest (Chin, 2010). Chin (2010) further notes that higher average loadings and a narrower range between 0.70 and 0.90 will allow greater confidence that all items converge in estimating the underlying construct. In essence, the narrower the range and the higher the lowest loading is, the more one can assume convergent validity (Chin, 2010). On the other hand, an AVE of less than 0.50 indicates that, on average, more error remains in the items than the variance explained by the construct (Chin, 2010).

This research also examines *discriminant validity* of the measures. Discriminant validity is the extent to which a construct is truly distinct from other constructs by empirical standards (Chin, 2010). By establishing discriminant validity, it implies that a construct is unique and captures phenomena not represented by other constructs in the research model (Hair et al., 2013; Straub et al., 2004). For the assessment of discriminant validity, two proposed measures are the Fornell-Larcker criterion and cross loadings (Hair, Ringle, & Sarstedt, 2011). With regards to the Fornell-Larcker criteria, for adequate discriminant validity, the square root of the AVE of each construct should be higher than its highest correlation with any other construct in the model (Hair et al., 2013; Hair et al., 2011). Another test of discriminant validity is obtained by examining the cross-loadings of the indicators (Chin, 2010). If the cross-loadings exceed the indicator's outer loadings, then there is a discriminant validity problem (Chin, 2010).

The third component of construct validity examined in this research is *nomological validity* which tests the strength of relationships between constructs to examine whether the constructs behave as they have in the past (or are expected to) within the nomological or theoretical network that the researchers have defined in the research (Straub et al., 2004). Nomological validity devolves from the existence of a well-developed theoretical research stream (i.e. a nomological network). It is supposed that if theoretically-derived constructs have been measured with validated instruments and tested against a variety of persons, settings, times, and technologies, then it can be argued that the constructs themselves are valid, forming a compelling argument (Straub et al., 2004).

Lastly, this research examines the *content validity* of the instrument items. Content validity refers to the degree to which the scales used represent the concepts about which generalizations are to be made (Bohrnstedt, 1970). In discussing content validity, Nunnally (1978, p. 258) points out that "rather than test the validity of measures after they have been constructed, one should ensure the validity by the plan and procedures for construction." To assure content validity, it is essential to specify the domain of the construct, and attempt to generate items that exhaust the domain, and subsequently purify the resulting scale (Churchill Jr, 1979). This can be established through literature reviews and several rounds of pretesting the instrument with different groups of expert judges or panels (Straub et al., 2004; Straub, 1989), which were done in this research.

3.6.2 Data Analysis: Using Partial Least Squares Approach to Path Modelling

Structural Equation Modelling can be used to measure the relationship between latent variables (constructs), that is, concepts that are abstract, complex and cannot be directly observed by means of multiple items (Hair et al., 2013). SEM is a powerful statistical method and is a second generation multivariate data analysis method (Hair et al., 2013). Multivariate data analysis involves the application of statistical methods that simultaneously analyze multiple variables representing measurements associated with individuals, companies, events, activities, situations, etc. SEM allows research questions to be evaluated by simultaneous modelling the relationships among multiple independent and dependent constructs (Gefen et al., 2000). SEM can therefore be used to explore theory (i.e., where the modelling involves developing theory) or to confirm theory (i.e. to test theory) (Hair et al., 2013).

There are two widely used types of SEM in Management Information System research, *Co- variance based structural equation modelling* (CBSEM) and the *Partial Least Square path modelling* approach to SEM, each having very different underlying philosophies, distributional assumptions, and estimate objectives (Gefen, Rigdon, & Straub, 2011; Haenlein & Kaplan, 2004; Hair et al., 2013). CBSEM is embodied in statistical packages such as LISREL and AMOS, while the component-based approach is widely used with PLS. PLS path modelling (PLS-PM) is more well-known and used in IS, and is embodied in packages such as XL-Stat, Smart PLS and PLS-Graph.

The PLS-PM approach was used in this research, as it is better suited for predictive applications and theory building (Gefen et al., 2000; Hair et al., 2013). Furthermore, Partial Least Squares (PLS) is considered a powerful method of analysis because of the minimal demands on measurement scales, sample size, and residual distributions (Chin, 2010). PLS is also considered better suited for explaining complex relationships, as it argued that “PLS comes to the fore in larger models, when the importance shifts from individual variables and parameters to packages of variables and aggregate parameters…” (Wold, 1985, p. 589). With PLS, all path coefficients are considered simultaneously hence the ability to analyse direct and indirect relationships among the constructs, in addition to estimating multiple individual item loadings in the context of a theoretically specified model (Lechner & Gudmundsson, 2014). Consequently it avoids biased and inconsistent parameter estimates for equations (Lechner & Gudmundsson, 2014).

Hair, Ringle, and Sarstedt (2011) outline ‘rules of thumbs’ that can guide researchers’ decision on whether to use CB-SEM or PLS-PM based on five (5) decision considerations: (i) research goals, (ii) measurement model specification, (iii) structural model, (iv) data characteristics and algorithm and (v) model evaluation (See Table 3.3). These ‘rules of thumbs’ provided greater support for choosing PLS-PM in this research. For example, with regards to research goal, since the goal was to predict key target constructs and identify ‘driver’ constructs for change, coupled with the fact that the research was exploratory (use of evolutionary lens), PLS-PM was well suited. Also, PLS does not require data normality and can provide reliable analysis even with smaller sample sizes. This characteristic fits well with the field study of this research, which has a relatively small sample size of 86 (and is too small for co-variance analyses). Hence, based on the guidelines listed in Table 3.4 and the advantages offered, the PLS-PM approach, it was thus used to analyse the quantitative findings in this study.

Table 3.4 Rules of Thumb for Selecting CB-SEM or PLS-PM

Research Goals

- If the goal is predicting key target constructs or identifying key 'driver' constructs, select PLS-SEM
- If the goal is theory testing, theory confirmation or comparison of alternative theories, select CB-SEM
- If the research is exploratory or an extension of an existing structural theory, select PLS-SEM

Measurement Model Specification

- If formative constructs are part of the structural model, select PLS-SEM
  Note that formative measures can also be used with CB-SEM but to do so requires accounting for relatively complex and limiting specification rules
- If error terms require additional specifications, such as covariation, select CB-SEM

Structural Model

- If the structural model is complex (many constructs and many indicators), select PLS-SEM
- If the model is nonrecursive, select CB-SEM

Data Characteristics and Algorithm

- If your data meets the CB-SEM assumptions exactly, for example, with respect to the minimum sample size and the distributional assumptions, select CB-SEM; otherwise PLS-SEM is a good appropriation of CB-SEM results
- Sample size considerations
  - If the sample size is relatively, select PLS-SEM. With large data sets, CB-SEM and PLS-SEM results are similar, provided that a large number of indicator variables are used to measure the latent constructs (consistency at large)
  - PLS-SEM minimum sample size should be equal to the larger of the following: (1) ten times the largest number of formative constructs used to measure one construct or (2) ten times the largest number of structural paths directed at a particular latent construct in the structural model
- If the data are to some extent nonnormal, use PLS-SEM; otherwise, under normal data conditions, CB-SEM and PLS-SEM results are highly similar, with CB-SEM providing slightly more precise model estimates
- If CB-SEM requirements cannot be met (e.g. model specification, identification, nonconvergence, data distributional assumptions) use PLS-SEM as a good approximation of CB-SEM results
- CB-SEM and PLS-SEM result should be similar. If not, check the model specification to ensure that CB-SEM was appropriately applied. If not, PLS-PM results are a good approximation of CB-SEM results

Model Evaluation

- If you need to use latent variable scores in subsequent analyses, PLS-SEM is best approach
- If your research requires a global goodness-of-fit criterion, then CB-SEM is the preferred approach
- If you need to test for measurement model invariance, use CB-SEM

Source: Hair, Ringle, and Sarstedt (2011)

3.6.2.1 Measurement and Structural Models

PLS is defined by two sets of linear equations: the measurement model and the structural model. The structural model, typically referred to as the *inner model* in the PLS‑PM context shows the relationships (paths) between a latent construct and its indicators (Hair et al., 2013; Hair et al., 2011). It represents a set of one or more dependence relationships linking the model constructs, and is most useful in representing the interrelationships of variables between dependence relationships (Gefen et al., 2000). On the other hand, the measurement models, also referred to as *outer models* in the PLS‑PM context include the unidirectional predictive relationships between a latent variable and its associated observed indicators (Hair et al., 2011; Henseler, Ringle, & Sinkovics, 2009). At the measurement model level, PLS estimates item loadings and weights, and residual covariance (Gefen et al., 2000).

Several techniques are used to evaluate both the measurement and structural models; however, prior to evaluating the measurement model it is important to recognise whether the latent constructs are formative or reflective (Chin, 2010).

3.6.2.2 Formative and Reflective Constructs

In PLS-PM, latent constructs can be modelled as either formative or reflective constructs. *Reflective* constructs have observed measures that are affected by an underlying latent, unobservable construct (Petter, Straub, & Rai, 2007). As such, changes in the underlying construct are hypothesized to cause changes in the indicators (Hair et al., 2011; Jarvis, MacKenzie, & Podsakoff, 2003). Reflective constructs are common throughout the IS literature being used to capture well-known concepts such as perceived ease of use, perceived usefulness, and satisfaction (Petter et al., 2007). For example, Perceived Ease of Use (PEOU) is defined, as "the degree to which a person believes that using a particular system would be free of effort" (Davis, 1989). With reference to Davis, six (6) reflective indicators are posited to measure PEOU: easy to learn, controllable, clear and understandable, flexible, easy to become skilful, and easy to use. Using this example, it can be argued that an increase in Perceived Ease of Use is reflected by an increase in all six (6) indicators (Freeze & Raschke, 2007). This means that respondent variations in the latent construct of perceived ease of use will cause *all* of its measures to reflect this change (Petter et al., 2007). Consequently, the measures all represent the underlying construct in a reflective model and are expected to be correlated (Freeze & Raschke, 2007), resulting in a high correlation as the reflective indicators are all dependent on the same unobservable variable (Haenlein & Kaplan, 2004). Due to the high correlations between the indicators, the indicators are also interchangeable and dropping an indicator should not alter the conceptual domain of the construct (Jarvis et al., 2003).

On the other hand, *formative constructs* consist of composite of multiple measures (Petter et al., 2007), and the indicators define and/or influence the construct (Freeze & Raschke, 2007). In contrast to reflective measures where a change in the construct affects the underlying measures, formative constructs work differently in that changes in the formative measures (indicators) cause changes in the underlying construct (Hair et al., 2011; Petter et al., 2007). In essence, as the name suggests, formative observed variables 'cause' the latent construct, representing different dimensions of it (Gefen et al., 2000). As such, observed variables are not assumed to be correlated with each other or to represent the same underlying dimension (Chin, 2010) which means that formative indicators of the same construct can have positive, negative, or zero correlation with one another (Haenlein & Kaplan, 2004). Thus a change in one indicator does not necessarily imply a similar directional change in the other (Haenlein & Kaplan, 2004), but rather each indicator may exist independently of the others (Chin, Gopal, & Salisbury, 1997).

To emphasize the difference between formative and reflective constructs in a model, the directionality of the arrows leading to the latent construct is used an indicator if the relationship between the construct and its measures. Formative items are represented with an arrow leading to the latent construct (i.e. Mode B), while reflective items are drawn with an arrow leading away from the latent construct, that is, Mode A (Gefen et al., 2000). Another outlook in examining the directionality of the arrow is to think about the eta as "causing the indicators" in the case of reflective constructs and "being caused by the indicators" in the case of formative constructs (Petter et al., 2007).

The above section discussed the differences between reflective and formative constructs, which are important as it determines how the model is evaluated. These coupled with the 'theory' that underpins the measurement model for each construct will serve as a guide in modelling the relationships in the conceptual model and subsequent analysis of these relationships in this research.

3.7 Ethics Consideration

This study followed the guidelines prescribed by the University of Canterbury Human Ethics Committee. As the study was conducted in two sequential data collection stages, two separate applications were submitted to the Human Ethics Committee. The first application in 2011 was submitted for the qualitative phase. The research information sheet and consent form prepared for the participants and the interview protocols were submitted along with the application form. The committee approved the application in the same month. After the interviews were conducted and a self-administered questionnaire was developed, a second application was lodged to the same committee in June 2013. The committee also approved this application and subsequent changes.

All participants were informed of the research objectives, voluntary participation, non-obligation to answer all the questions and confidentiality of their participation, and assured of their anonymity when the outcome of the findings was published. In addition, interviewees were asked to sign a consent form, which informed them of their right to withdraw from the study at any time up until the data is processed and added to the other data that has been collected. See Appendices B to E for documents related to the qualitative phase, and Appendix J for the survey instrument (which includes a cover sheet with information on the research and consent information).

3.8 Chapter Reflection

This chapter detailed the research method used to investigate changes in IS use in this study. It uses a mixed method approach, with a qualitative phase (Phase 1) followed by a quantitative phase (Phase 2). Phase 1 used interviews as the primary source of data collection to understand changes in use, and involved interviewing thirty-nine (39) users across three (3) organizations. This proved valuable to the research in understanding the intricacies of post-adoptive behaviours. As succinctly put by Myers (1997, p. 3) in support of qualitative research, “if there is one thing which distinguishes humans from the natural world, it is our ability to talk!” Phase 2 was confirmatory and used a quantitative mode of enquiry. For Phase 2, findings from the case studies together with key theories were used to frame the research model for further analysis.

Chapter 4. Case Study Analysis

"I want to understand the world from your point of view. I want to know what you know in the way you know it. I want to understand the meaning of your experience…Will you become my teacher and help me understand?" [James P. Spradley]

4.1 Chapter Overview

This chapter describes the findings from the case study interviews, that is, the qualitative phase of the research. The aim of this chapter is to present an evolutionary perspective on post-adoption use, using the mechanisms of variation, selection and retention. By applying Generalized Darwinism, the explanation includes how *variations* occur so that behaviours with observable and interesting differences are produced through some process (Farrell & Shalizi, 2012); how some principles operate to *select particular variants* and how variations that have been selected are preserved, that is *retention* (Aldrich, 1999; Hodgson, 2008; Hodgson & Knudsen, 2008). This chapter therefore details participants' changes in use over time, using an evolutionary perspective to examine and understand the change process as it unfolded.

In this study, data analysis took the form of a with-in case analysis followed by cross-case analysis. The report of the findings from the three (3) case studies on the other hand, took the form of a comparative description which focuses on the emerging themes rather than the situationality of each case (Stake, 2006). The combined approaches used for the analysis of the data and report of the findings therefore seek to capture not only the key themes and commonalities across the cases, but also the differences that would help the reader to get a more consolidated and extensive understanding of change in use. These results are summarized in Table 4.1 at the end of this chapter.

4.2 Research Sites

To provide the context for the findings from the qualitative data, this section describes the case organizations, and provides a summary of the IS studied in each firm and the types of users interviewed. Three (3) organizations with diverse business foci: Agriculture, Energy and Communication Technologies using Complex Information Systems: Customer Relationship Management System, Information Technology Service Management and Collaboration System respectively participated in this study. In total thirty-nine (39) users were interviewed.

4.2.1 Case Study 1 (AgriCo): Use of Customer Relationship Management System

4.2.1.1 *Case Site*

This case study was conducted in a large organization in the agricultural sector in New Zealand, which supplies a range of agricultural products and services to the local market. For the purpose of this research, the organization will be called 'AgriCo'.

AgriCo has been in operation for over 30 years, and started as a fertilizer company. The company was formed by a group of farmers who came together and reasoned that if they imported fertilizers and also manufactured it themselves, they could access fertilizers at a lower cost. As a result, a corporative was formed, with AgriCo being owned today by about 35,000 New Zealand farmers. The spirit on which AgriCo was built still remains, as the company still aims to achieve the lowest possible cost for its farmers, as related by the Chief Information Officer (CIO) during the interview,

> *"We continue to strive to have all of our products and services at the lowest possible cost because they own us. They are saying that is what we want our company to do for us- is to give us all those products at the lowest cost… You really are working for your customers, because they are shareholders as well. So it's a little bit of a different slant from some corporates.*" [CIO_AgriCo]

AgriCo manufactures its own core fertilizer products, and has several manufacturing stations and consignment stores all across New Zealand. In the last ten years, AgriCo has diversified its product lines from fertilizer only, and now offers a wider range of products and services to farmers. These products include agrochemicals, lime, animal health supplements, drenches, and other nutritional products for farm stock. Services offered include soil and animal testing.

All manufacturing sites supply to local distribution points and also to small enterprises and towns within New Zealand. AgriCo takes pride in the relationship it has with its farmers, noting that:

> *"We own that entire supply chain out to the farmer, and we sell directly to them too. I guess that's the other distinction between ourselves and the competition. So we don't use other companies to sell our products, we sell directly to our farmers. So it's a very beneficial supply chain for us and we understand our customers very closely because they are direct customers as opposed to using one of the rural merchants that would sell fertilizer for you, but you lose that direct contact with your customer. So that's another distinction with AgriCo that we deal direct."* [CIO_AgriCo]

Besides manufacturing and delivering products to farms, AgriCo is equipped with a large fleet of spreading trucks and aircrafts that it uses to apply fertilizers and nutrients on farms. This places

AgriCo in quite a unique position, as it has full control of the supply chain - procurement, manufacturing, delivery and application of products. Since all Sales personnel are tertiary qualified with agronomics degrees, AgriCo is equipped to help farmers manage all aspects of their farm(s):

> *"They [Sales Personnel] are not just out there saying this is what our product does, it's cheaper or whatever. They are saying [to the customer] what do you want to do with your farm? What are your goals? -And understand those and then we say [to the customer] 'we think you could do with this' or 'actually you shouldn't buy our products this year, you have already got the right fertility"* [CIO_AgriCo]

By offering products and services directly to farmers, AgriCo distinguishes itself from competitors, as the CIO remarked, "[*we have*] *total knowledge of what happens to our products and everything that our customers do with our products*", which is "*relatively unique in New Zealand and internationally as well.*"

4.2.1.2 *Information System – Customer Relationship Management*

AgriCo has a number of enterprise systems, and prides itself as a high end user of technology. As the CIO commented, "*we use a lot of technology right through all different parts of our business, and because we are growing, there are always different requirements. Nothing is the same every year, so everyone is always on their toes trying to keep up with where the company is going and achieving efficiencies and those sorts of things.*"

The most significant Enterprise system that AgriCo uses is a *Customer Relationship Management* (CRM) system, which forms the backbone of its operations. Prior to the CRM implementation, AgriCo used intermediaries (that is, retailers) to sell its products, who would then sell directly to the customers. However AgriCo changed its strategy and decided to handle their customers directly. With over 25,000 customers, there was a need for a superior system to manage their clients, thus the CRM was implemented.

The CRM has been upgraded over the years, with vendor upgrades, embedded tools and unique customization as AgriCo "grows with the system." AgriCo uses the CRM, not just as a traditional CRM, but has adapted it to better reflect the business and more effectively manage the entire supply chain, *"This product [the CRM] has very good upgrade paths for modifications, so even if you are highly modified, you can take up the next version of the product and pull through your modifications with very little overhead. And so it means that it's worth investing in making it unique to really sit very closely aligned with the way you do business. You don't have to conform to the way the manufacturer expects you do business; you can change it, and not have to pay a penalty because of it. So I think that's a really positive attribute of our particular CRM."* [CIO_AgriCo]

4.2.1.3 *Main Users of the CRM*

There are two (2) key user groups of the CRM: (i) Customer Service Representatives (CSR) and (ii) Account Managers (AM). Both use the system in distinct ways to reflect their different roles and needs.

The CRM is used by CSRs in the call centres to record and update customer details, record and handle customers' queries, transact sales, and general management of the client's information. On the other hand, the Account Managers are assigned several clients (of varying farm sizes) and ultimately manage these clients' accounts. When the CRM system was introduced, the CIO recounted that some Account Managers were reluctant to use the system, thus the Chief Executive Officer (CEO) took drastic methods to encourage the use of the CRM:

"We started firing persons because they weren't using it and then they started using it. Our CEO was very committed to it, and that goes for all of our technologies. He's a very forward thinking CEO, and we knew that unless we took control in a systematic way of our customer information and the way we deal with our customers, then we would lose the plot." [CIO]

AgriCo deploys the CRM to all Account Managers, who are often in the field. Unlike Customer Service Representatives, the Account Managers have an offline version of the system on their laptops that they synchronize to keep the data updated and maintained. With each Account Manager having over 100 clients, the CRM provides a wealth of information that can be used to understand and manage their customer relationships.

In summary, both Customer Service Representatives and the Account Managers use the CRM to support their work. The Account Managers use the CRM system proactively, for example, for searching for customers, making appointments, identifying and targeting customers' farm needs and prospecting. On the other hand, the Customer Service Representatives will mostly use the System when the customer contacts AgriCo.

Fundamentally, since AgriCo is a customer-oriented firm, and the CRM is the heart of its operations, how and the extent to which individuals use the system is paramount:

> *"It [the CRM system] really helps with engendering loyalty from our customers, because they feel as if you know them well - you get that connection with them. And so, if people use the system well then you can make a customer that you have had very little contact with feel good, and that you understand them- you have heard their complaint - or you know that they are happy. And so, they [the customers] stick with you because they feel like they are a part of it [the company]. Where if you don't know information about somebody… they feel like they are just another number, and I suppose it's up to us really to use that information well to make that loyalty stay in place."* [CIO_AgriCo]

4.2.1.4 *Participants*

In total, nineteen (19) users volunteered to participate in the research. In terms of key user groups, there were 9 Customer Service Representatives (CSR) and 10 Account Managers (AM). Among the 9 CSR users, the breakdown was: 1 basic user, 4 intermediate users and 4 advanced users. For the AMs, these were 2 basic users, 3 intermediate users and 5 advanced users.

In addition, the Chief Information Officer and the in-house trainer were interviewed to gain background information on the CRM and insights on its use. Other methods of data collection included observation and document review (e.g. training materials, system documentation). The observations included watching CSRs use the system in the Customer Centre as they handled live calls. Also the researcher was provided with a walkthrough of the CRM by the in-house trainer.

4.2.2 Case Study 2 (EnergyCo): Use of Information Technology Service Management (ITSM) System

4.2.2.1 *Case Site*

EnergyCo (pseudonym) has been in operation for over 20 years, and is one of the largest energy generators in New Zealand. The firm supplies electricity to over 250,000 customers, including residential and business properties and farms. EnergyCo employs over 700 permanent employees and around 500 contractors in its offices in Christchurch, Auckland, and Wellington.

Generating approximately 40% of New Zealand's electricity, EnergyCo owns and operates a number of hydroelectric power stations and wind farms. The company prides itself on developing only renewable energy and the culture and philosophy of EnergyCo is to continuously improve operational efficiency. EnergyCo has attained noteworthy energy efficiency savings across its business, and also has initiatives that focus on recycling, such as education programs on energy conservation practices.

EnergyCo continues to innovate and develop new technology, new products and new ways of operating as it identifies new sustainability initiatives for future generations.

4.2.1.2 *Information Systems – IT Service Management*

One of the main enterprise systems in EnergyCo is their *Information Technology Service Management (ITSM) System*. The ITSM was implemented in 2007 to align the delivery of information technology services with the needs of the business, emphasizing benefits to customers, and also for managing its vendors. EnergyCo uses the ITSM for IT Service Support, service desk management, IT Service Delivery and IT asset management.

For IT Service Support, the ITSM handles configuration management, change management, release management, incident management and problem management. Configuration management relates to the physical and logical aspects of the IT infrastructure and the IT services being provided. Release Management includes testing, verification, and release of changes to the IT environment. Incident Management involves the day-to-day process that restores ‘normal’ acceptable service with nominal impact on business. For problem management, the ITSM is used to diagnose root causes of incidents, so as to eliminate and consequently manage them. Another primary IT service in the ITSM is the service desk, which provides a single point of contact to meet the communication needs of both users and IT staff.

EnergyCo also uses the system for IT Service Delivery, so as to optimize IT infrastructure capabilities, services, support and minimize service outages, and provide sustained levels of service to meet the firm’s requirements. In addition, the ITSM is used to manage EnergyCo’s resources, and to maintain and improve the level of service that it provides to its customers. The ITSM is quite multi-faceted, as it also provides financial management services for IT.

4.2.2.3 *Participants*

EnergyCo has approximately 60 high-end (that is, IT users), but all staff members have access to the ITSM, which they use to access IT services. This case study focused on the high-end users, as they use the back-end of the system for IT Service Support and Delivery, and have greater variety and flexibility in their use of the ITSM.

In total nine (9) individuals volunteered to participate in the research, that is, 3 basic, 2 intermediate, and 4 advanced users. In addition, the Applications Service Delivery Manager was interviewed to gain insights into the ITSM, and to provide a walkthrough of the system. Documentation, such as training manuals and documented workflows were also provided to the researcher.

4.2.3 Case Study 3 (CommCo): Use of Collaboration System

4.2.3.1 *Case Site*

For more than 20 years, CommCo (pseudonym) has been designing and manufacturing mobile communication technologies, for both the local and international market. The firm employs over nine hundred (900) staff worldwide. CommCo offers a wide variety of mobiles, portables and base stations products for taxi and private hire companies. The firm also offers services such as network design, installation and support. CommCo, known as a leader in innovation, continually invests in research and development and manufacturing technology in order to provide world-class, high quality and reliable mobile data solutions.

CommCo prides itself on being committed to meeting their clients' needs by remaining open, flexible and responsive to customers' unique requirements; hence all of their equipment is designed to be malleable. CommCo clients include civil police forces, airlines, and rail transportation providers in several countries.

4.2.3.2 *Information Systems- Collaboration System*

CommCo implemented a Collaboration System over three (3) years ago to address the growing need for increased collaboration within and across offices locally and internationally.

The Collaboration System enables staff to work together within and across departments, and over geographical distances in a coordinated fashion by providing tools that aid communication, problem solving and collaboration. The Collaboration System provides project management functions, such as shared calendars, allocation of tasks and time management. Furthermore, members of a team can use the system to access detailed information on a project such as the status of the project (e.g. track and chart the cycle of the project).

Another function that the Collaboration System offers is document management which tracks and stores electronic documents and makes these accessible to users. It provides a collaborative workspace, where users can work together on projects, share files and discuss revisions. Other features include version control and tracking, and a range of other collaborative project management tools. The Collaboration System also offers social software applications, which allow users to set up their own page and create profiles, wikis, blogs, and forums.

Use of the Collaboration System is largely voluntary, however the CIO described it as '*almost mandatory'*, as the same system is used to support the company's Intranet, which all staff access. Furthermore, the Collaboration System serves as a portal or hub through which users access internal applications such as the Human Resource system, the help system, the library, the mail system and other enterprise systems. Fundamentally, "*[the System] is the front page for people. So in that respect, it's almost mandator*y." There is variability or flexibility in use, as while some users can opt not to use the system for their work, for others, it is a major IS that they use to support their work.

4.2.3.3 *Participants*

In total eleven (11) individuals volunteered to participate in the research. This included 2 basic, 5 intermediate, and 4 advanced users. The focus was on individuals that use the Collaboration System for more than accessing other systems, that is, as a portal. Additionally, the CIO was interviewed to gain insights into the Collaboration System. CommCo's in-house trainer also provided the researcher with a walkthrough of the Collaboration System. Documentation, such as training manuals was also used to further learn about the Collaboration System.

In closing, Section 4.2 describes each of the case organizations, the IS investigated and the types of users that were interviewed. The next sections report on the findings from the qualitative data drawn from user interviews.

4.3 Variations

Variation is defined as change from current routines (Aldrich, 1999). Variation, in this context introduces alternatives in how the IS can be used to accomplish work tasks, and represents a departure from how one currently performs a routine (i.e. actions) using the IS. The case findings revealed that variations (in actions) included (i) *Using formerly unused (available) features,* (ii) *Modifying use of currently used set of features,* (iii) *Substituting or replacing one (already-used) feature with another feature* and (iv) *Finding novel or innovative uses* of IS features.

All thirty-nine (39) participants in the interviews had enacted at least one form of variation. Using formerly unused (available) features to perform a task was the most common of the form of variation. The second most common form of variation was modifying use of currently used set of features, followed by substituting features. Finding innovative or new use of features was the least common form of variation enacted by the interviewees, but when this occurred, it was more evident among advanced users. Each of these variations is discussed further below.

4.3.1. Using formerly unused (available) features

The findings revealed that as participants interacted with the IS over time, they applied new features to perform work tasks. Across all three (3) firms, there were numerous mentions of this form of variation, as users described how they used additional features to enact work routines. For instance, at AgriCo, some users remarked that they have started to use "*more and more*" aspects of the CRM, or as one user described it, he/she has been "*going into places*" in the CRM. Sample quotes to illustrate this form of variation include:

> *"Probably at the start of my six months, I was probably just really using the customer service tool, and just using the clients' details which are loaded onto our service personal page, which is the people we look after. But probably in the last three months, I'm starting to use more and more of the other pages."* [Basic User_AgriCo]

> *"I'm going into places [in the System] and using all these tabs [pointing on the screen] …. sort of navigating around…"* [Intermediate User_AgriCo]

> *"I use more features of the CRM now, 'cause when I first started I wouldn't have created fertilizer plans or monitored campaigns, or monitored accounts with it; like when I started, it was basically the order goes in and that was about it. Now, I use far more features."* [Advanced User_AgriCo]

At EnergyCo, similar forms of variations were evident as users described how they explored new features of the ITSM. For example, a user described how he started to use the 'work flow diagram' tool in the ITSM, recounting, "*I started using a lot more features to try and understand exactly where it [the change request] was in the process." [Basic User]*

Another user (advanced) shared that over time, "*I just got to learn the program [ITSM]*", with an example including *"just setting up more monitors so that I can keep an eye on what's happening."* The user continued to explain, *"I don't deal with the incident or the calls, but I need to know what's going on and the impact on the change side. So I set up a monitor to monitor all the Priority 1 cases that come in. So if I see that spark, I know that there is a new one and it could potentially come to the change space where we need to be doing an emergency change."*

Users at CommCo, in their use of the Collaboration System, related similar actions. For example, a user shared that she started to use the project management tools, stating, "*it gives you milestones where you can put it in to do reminders and so on. It allows me to do documents [and] allow people to comment onto anything that I've posted in there, which was quite helpful. And it allows me to organize it into different sub-spaces."*

In summary, this form of variation, that is, using formerly unused (available) features, included the act of using more features of the IS by experimenting with new (formerly unused) features to support their work.

4.3.2 Modifying use of currently used set of features

As use of the IS changed over time, some participants recounted modifying their use of currently used features. This was evident as users spoke about making improved or more sophisticated use of currently used sets of features.

An example that was shared by users at both AgriCo and EnergyCo was an improvement in the use of the 'search' feature. At AgriCo, for example, variation occurred as users became better at specifying search criteria and filtering the results, as a user shared *"I'll [now] be more specific as to what I'm actually looking for. There's no point in me pulling up a screen with 1000 customers when I'm really only looking for 100 [customers]. So the criteria would be whittled down more, and more and more...whereas in the past I may not have set it, so it pulled up all of them."* [Advanced User_AgriCo]. Another advanced user at AgriCo described a similar type of use, *"the first time I used them [segment feature] they were actually for running reports from Field days…. And then once I learnt how to actually use them and manipulate them, then I started using them a bit more…much better…you change where you're looking [the criteria] and then you can cut down the search."*

Users at EnergyCo in using the ITSM provided similar examples, where variation occurred through modifying how they set search parameters and search criteria. For instance,

> *"I just got better at searching for information and that was probably the main thing…I became more fluent in the tool. It was really just searching and interrogating. I became a bit more specific by defining things down by searching by either business unit or by creator of the request. Just really extra search fields, that was about it really."* [Intermediate User_AgriCo]

Variations of this form also involved making more sophisticated use of currently used sets of features. For example, a user at CommCo described how his/her use of previously used features was refined in creating a page in the Collaboration System,

> *"The documents editing features is quite rich, so I've probably got a bit more sophisticated as I've been using that. Initially it would have been just 'fill in the page' and then 'publish a page', but because it's got rich text in there - it's like start a document and then go back and edit it. So, you can keep it as a work in progress until you're ready to publish it or you can publish it and then add to it and then circulate*

again. You can put in different text formats. You can put paragraphs and headings and tables. It's not sophisticated but it does mean you can put a bit of layout information onto a page to make it a bit better for the type of information you want to share - so that's quite useful." [Intermediate User_CommCo]

Another example of sophisticated use was found in the application of the CRM. For instance, the mail-merging tool allows users to quickly produce letters to send to a group of customers. Users of the CRM can select the customers by searching on their name/s, running a segment or creating a bucket. However, when segment and bucket features are used together, the mail merge is used at a higher level of sophistication. For example,

"…it was 1500 customers, and because we needed them in certain areas, I ran a segment first until I got all the customers that fell within that criteria, exported that to excel and then saved it and created a bucket, so that all those customer numbers fell in the bucket, then I created the mail merge letter and then merged the two to send the letters to the customers. So each area was a different list and that was the easiest way to do it." [Advanced User_AgriCo]

In summary, as use of the IS evolved, some participants described modifying their use of already used features, resulting in improved or more sophisticated use of the features. In short, they used the IS to augment or refine their existing ways of performing tasks, by using currently used sets of features '*better*'.

4.3.3 Substituting or replacing one (already-used) feature with another feature

Substituting as a form of variation involved replacing one feature with another that can perform a similar task (Sun, 2012). For example, a user recounted how over time, she started to use the 'search' function instead of the 'report', relating "*I had more criteria that I could put in, and get the data that I actually needed. So I find myself now using the search function and changing all the criteria to get what I need, rather than using the reports."* [Advanced User_EnergyCo]

In another example, a user at AgriCo detailed how she started using the 'results tree' feature instead of a particular tab, because "*it's easier to look up for a specific order, so you can look through call activities on the tab and find out when an order was placed, but it doesn't actually tell you exactly what was on the order*." She then continued to explain, "*so a customer may ring up and say I ordered some [product name] a little while ago. So instead of having to go through all of their orders from call activities, you can just go to the tree, click on orders, find the product, and go straight to the order."*

In essence, as variations occurred over time, some users sought to replace currently used sets of features with other features - with similar functions.

4.3.4 Finding new or innovative uses of various IS features

Finally, the fourth type of variation that occurred was new or innovative use of various IS features. Some users (typically, advanced users) discovered new or innovative ways to use the IS to support their work. For example, at CommCo, one user created a 'page' (in the Collaboration System), and used it as a repository for his "*own kind of personal record",* as shared below:

> *"I've got a particular project that I'm wanting to do so I'm using the ITSM to store information related to that - just some short notes and some URLs, some videos that are around - so I've created a page for my own kind of personal record of that topic."* [Intermediate User]

In another example, an advanced user started to use 'segments' in the CRM to "*check that the team is using the correct naming convention for special mixes in Queensland* ", which was different from the typical use of 'segments' (that is, pulling customers' information). Another instance of innovative use, was seen in the use of a 'monitor' feature to manage change incidents, as described by the user,

> "*I set up a lot more monitoring so I know where everything is, instead of having to enter the number and see where it is…I would look on the fields in the actual call, and figure out which ones I need and then just go and find them in a report format and then collate that tree… I can just set up monitors and so I know exactly where it is in the process if I have to chase it. Instead of having to click on the request, and then click on another button to see where it is in the workflow, and then double click on that to see who's got it. I found that quite useful."* [Advanced User_EnergyCo]

In summary, some users recounted stories which suggested variations in the form of new or innovative uses of the IS. These concern users' engagement in innovative and novel ways of using the IS to perform work tasks.

Altogether, the case findings revealed four (4) various types of variations, namely, *using formerly unused (available) features, modifying use of currently used set of features,* s*ubstituting or replacing one (already-used) feature with another feature* and *finding novel or innovative uses* of IS features. The next section of this chapter examines factors that influence variation, that is, the triggers, and/or enablers and inhibitors that lead to the variations described above in the section 4.3.1 to 4.3.4.

4.4 Triggers and Enablers of Variations

This section details the triggers and enablers of variations drawn from the interviews. The findings revealed five (5) key triggers and/or enablers of variations: *peer learning*, *IS Support*, *intrinsic motivation*, *extrinsic motivation*, and *domain-related knowledge*.

4.4.1 Peer Learning

"You're told what's available, you have a go at it, you ask others when you can't do something, or you see somebody else do something that you hadn't thought of or didn't realize you could do. So that informal sort of training through with your peers helps" [User]

Individuals have different levels of expertise and this is indicative of the varying levels of utilization of the IS observed across the firms and user types. Across all three (3) firms, the findings revealed that peer learning was a salient factor that either triggered and/or enabled variations. Peer learning, in the context of the findings, is defined as the acquisition of knowledge and skill through active helping and supporting among status equals or matched companions (Topping, 2005). For some, peer learning influenced variations a great deal,

> *"It [learning from peers] would have probably [contributed to] 30 to 50 percent of how to better utilize the CRM system really. In initial [formal] training, everybody would pick up something different out of the initial training…[but] the informal training later on was really what sort of helped you pick up things that you might have not focused on at the time… You're told what's available, you have a go at it, you ask others when you can't do something, or you see somebody else do something that you hadn't thought of or didn't realize you could do. So that informal sort of training through with your peers."* [Advanced User_AgriCo]

> *To me, they [peers] are a better source of training than to actually go on a formal course. Courses are generic, designed to give an overview; designed to give knowledge of what that trainer or the person, the instructor and the trainer thinks someone might need. Whereas [with peer] coaching you've got a task. You don't get confused by all the other bits and pieces that you need to know; you just need to find out what you need to know [for the task]. So it's more targeted.*" [Basic User_EnergyCo]

The interviews revealed that peer learning was beneficial in generating variations as it allowed participants to become more aware of the array of features available in the IS. This deepened some participants' understanding of how the IS can be applied in their specific job role and context. Also, users were able to recognize and identify various uses of the IS through their peers' use of the System.

In the case studies, peer learning was evident through different mechanisms namely, *peer observation*, *peer-to-peer training, peer-developed documentation*, and *online forums*. The case findings below are discussed in terms of how these different mechanisms for peer learning played a role in triggering and enabling variations.

4.4.1.1 *Peer Observation*

Peer observation was evident in the cases, and involved users observing colleagues use of the IS. Indeed, learning seemed to occur 'almost' naturally through peer observation, which provided a forum for learning through exposure, contemplation and imitation. As a user recounted, variation emerged from "*seeing how different people do it...some people prefer to do things other ways... Just by you sitting with other people and seeing how they do it, and trying out the different ways"* [Basic User_AgriCo]. In another example, a user described how variation occurred by imitating others, "*our team leaders are quite good at doing those sorts of things, so I learn a lot by just watching. So every time I needed something done I would just watch them do it as well*" [Advanced User_AgriCo]. Another user at EnergyCo shared similar sentiments,

> "*[I learn] just by watching other people at their desk, they show you things, you can see how they doing and they might press different buttons, like instead of double clicking I might press the little view button, and we both get the same results. And I'm always aware of stuff like that cause I think that's not how I use it. And sometimes I will try and do it their way."* [Advanced User_EnergyCo]

By observing others' use of the IS, "[seeing] *what other people are doing*", peer learning through peer observation served as a factor that facilitated variations. This exposed users to new ways of using the IS, which resulted in actions such as use of formerly unused feature or refining use of currently used features. Further evidence in support of peer learning as a way of enabling variations are provided below,

> *"Well, I guess you copy other people. You see what other people are doing and you use similar things…so it's like do they use a group or a space? What kind of documents do they use or do they use blogs or documents or projects within a space? So, you're kind of seeing what other people are doing and what looks successful and you kind of make use of that. An example would be you can embed videos so you kind of see someone else has done that and then think, okay, let's try that and see how that works…I kind of see what other people are doing and just maybe ask them, "How did you do that?" and then just pick it up from there… but it's very informal."* [Intermediate User_CommCo]

> *"I'm always about exploring what people are doing. So I think with the different spaces that they've done and if you're interested in one particular thing, that would actually help you want to explore those areas if you need to or if you're inclined to do so, so that was quite good. "* [Intermediate User_CommCo]

> *"... where I've seen a page that I particular like and I'll go and ask the person who created that page for some ideas about how it worked for them and issues they had with it as well…I think from other peers, you know seeing people's other spaces and just saying 'well okay it can actually be done', or 'I probably need to change something'…Yeah it's just a case of doing it I think - to actually see whether it all works, like what I had in my mind and what will actually work."* [Intermediate User_CommCo]

There were also more formal approaches to learning by way of peer observation. For example, at AgriCo there was a 'buddy system' in some departments, where new or less experienced CRM users were paired with more advanced users to facilitate further learning about the IS. This created opportunities for users to pass on their knowledge and experience about the System, and served as a "*good way to learn all the different functions of the CRM."* As related by users:

> *"Well I suppose 'cause I'm fairly new to this role, we are given a lot of time to work with more senior staff that have been using the system a lot longer to do their particular role."* [Basic User_AgriCo]

> *"We do a lot of what we call 'buddying', so we will have new CSRs sitting with you at your desk, listening on calls, watching you use the CRM, watching the different functions that an experienced CSR would use."* [Advanced User_AgriCo]

> *"They [management] ask us old ones to show the new ones how to use it [the IS] (interviewee laughs)…I spend a bit of time with new people, and sit down with them and show them how to operate it [the IS]…When...we have a new one [Account Manager] that starts in the area, there might be a day or a couple days of them with me out in the field."* [Intermediate User_AgriCo]

In summary, peer observation was a valuable tool for both the observed and the observer as it facilitated the sharing of knowledge on aspects of the IS, dissemination of good practice in using the IS, and the emergence of variations.

4.4.1.2 *Peer-to-Peer training*

Peer-to-peer training took multiple forms, such as casual conversations, participants questioning their peers (in most cases, more advanced users), or impromptu demonstrations of use of the IS features. In many instances, peer learning occurred on a 'need-to-know basis' as opposed to planned interactions. As one user related, "*when I couldn't do something, I'd ask, 'How do you do this?', and they [peers] would show me*" [Basic User_EnergyCo]. With that said, there were however instances of variations emerging from more formal peer-to-peer training sessions. Through peer-to-peer training, participants were able to work together to reflect on current practices (in how the IS in used to perform certain tasks), expand and refine use of the IS, and solve problems in terms of 'how' to use particular features. As users shared,

> *"...each time we had a team meeting we would have a small session on what we could do; what was something that was available. If somebody was very proficient at a certain part they would show people what they did and pass on that information. So that was very good that sort of semi-formal training in a small group situation."* [Advanced User_AgriCo]

> *"If it's a sales meeting or something, we've all got our computers and that there, and if we've got an issue, we can ask each other, 'How do you do this?' or, 'How do you do that?' and yeah, it's very, very easy, 'cause some are more okay with it than others as such, and or a quick phone and bingo we get it sorted."* [Intermediate User_AgriCo]

> *"He [the Manager] would perhaps identify somebody that was good at this certain thing that he'd noticed them using, that he thought might benefit the rest of the group, and he would encourage them to show everybody at the team meeting."* [Advanced User_AgriCo]

4.4.1.3 *Peer-developed documentation*

The case findings revealed that in some instances, participants documented their knowledge of particular 'steps' and 'instructions' for using aspects of the IS. In an example at CommCo, an intermediate user shared how her predecessor documented *"all the steps, for uploading photo, uploading a link, uploading video",* which had been instrumental in her learning how to use particular features.

In another example at AgriCo, a user related how tips from colleagues on "*how to do something*" in the CRM enabled further variation:

> *"We sometimes just get email…somebody may ask a team leader a question about how to do something, so then the team leader will communicate that in an email to everybody saying - just in case you want to know - this is how you do 'said thing'. So those are really good… Sometimes it's something I didn't know it could do, and other times I knew it was possible but I didn't know how to do it. So either way, we do it more efficiently, so they are good…we only had one [email] just yesterday, which is about 'call popping', which brings up the customer's record in front of you. I never even noticed they [the features] were there until the team leader emailed us yesterday saying - remember that they are there and this is what you can use them for…So yeah, that was really good."* [Intermediate User_AgriCo]

4.4.1.4 *Online forums*

At CommCo, there was an online discussion forum that served as a platform for sharing knowledge on use of the Collaboration System. In this forum, enabled by the Collaboration System, users could submit and respond to queries, or just generally share information or tips. Participants revealed that the online forum facilitated discussion on "*what are things that need doing" and "what are the things they [colleagues] have actually created",* hence "*there was learning*". The forum was deemed useful, as participants were able to view previously asked questions, to which a wide array of responses was provided. Quotes by participants included,

> *"... if you need help, you can just email the team and just say, "I can't remember how to do this," or, "I want to do this, but any ideas how to do it?" And people will just post suggestions or you can go along to them and see what's what."* [Intermediate User_CommCo]

> *"There is a bit of information there [in the forum]…you could make the comment or, say "this isn't working," or, "How can you do this and that… Yeah so anything we found out we put into that group, so that other members could go in and read the information. I've gone there [the forum] a few times just to see what other people are saying... [also] you get emails when somebody posts something."* [Advanced User_CommCo]

In concluding, in all three (3) firms, the findings suggest that peer learning was a key factor influencing variations. As one participant related "*they've [peers] played a pretty important role because they use the program [the System] on a day to day basis as well. So if they're having an issue or if you're having an issue, one of them is going to be pretty familiar with it. So you know you ask them for advice or vice versa*." Another participant shared that more advanced peers are the likely choice in guiding one's use, stating that "*invariably if you give 10 people an application, I think after a while one or two people would stand out as the super users. And so [colleague's name] was probably the super user of my peer group and that was the logical person to say to, "What's going on*?"

4.4.2 IS Support

In the case studies, IS Support was evident in two forms (i) On-going formal training and (ii) 'hot tips', which played important roles in facilitating variations.

4.4.2.1 *On-going Formal Training*

On-going formal training was a salient factor that clearly influenced the extent to which users engaged in variations. The findings revealed that while initial training was good at early stages of adoption, (e.g. to get started), on-going training enabled deeper use of the IS. On-going training facilitated and encouraged individuals to engage in variation, through providing information about the features of the IS, which in turn reduced uncertainty about how to use the System. Some participants also indicated that on-going training provided "*exposure*" to the features of the system, and provided an avenue to learn about *"what's available and what other people use."* Thus, although initial training equipped users with the initial (often basic) operational skills to use the IS, on-going training provided the opportunity to delve further into aspects of the System and to keep abreast with changes in the system (e.g. new or revised features). This provided some participants with a better understanding of the IS which played a role in varying use behaviours. As two users commented,

> *"…After you've been in the job and had a chance to have a wee play with it, then we get some one-to-one* [formal] *training, which is a little bit more deep than just the normal stuff you need to do."* [Basic User_AgriCo]

> *"[Trainer's name] makes you aware of it, so you use it and you see that it makes the job easier; so that you continue to use it and then you get good at using it."* [Basic User_AgriCo]

Furthermore, on-going training facilitated variations, as it provided participants with opportunities to ask questions more specific to their job role, especially after they have gained familiarity with the IS, and then need further guidance. As one user recounted,

> "*Whereas the first session was more going through telling us about the tools, it [on-going training] was more of a two way thing where I could come back and ask question…you got a lot more feedback rather than just being shown what to do. Cause we'd used the*

tool, you could come back and sort of ask questions, say like, "How do I do this?" and that sort of thing." [Basic User_EnergyCo]

Some participants noted that they relied on training as one of the key resources to increase and enhance their use of the IS, as it provided them with the skills needed to effectively accomplish their work task. As one user remarked, *"I'm big on those training classes... you self-teach yourself in a lot of ways like Word, Excel and that you can be very, very good at it. But you go along to a training course and there's so many little hints and tips that you were not aware of. So I'm big on taking up on training and just trying to pick up that little bit of extra help, it makes the job easier and faster."* [Advanced User_CommCo]

Some training sessions focused on more advanced features, as one participant recounted, "*we have had about 2 or 3 sessions where we have had one of the guys from EnergyCo actually walk us through it at a more advanced level that to what we need. So that we can know what it does."* [Advanced User_EnergyCo]

Additionally, some training sessions were also specific, focusing on an aspect of the IS that was new, underutilized or difficult for users to grasp on their own,

> *"When a new function is put into the CRM…. If it gets too much in-depth, then the team leaders will look at it and say we will need to have some training on this. And so, they will get usually one of the IT Team to come and talk to us about it and actually demonstrate how it works."* [Advanced User_AgriCo]

Users also recounted examples of variations (such as use of new features, modifying use of currently used features) that were triggered and/or enabled through formal training session:

> *"[Trainer's name] taught me how to do it [search]…Finding customers that are in the area that I'm going to go travelling to…I had another Excel sheet, so I knew where the customers lived. So I was just doing that in my head...whereas if you do it through the CRM system, you don't have to think about it really. You just click a button and they all pop up."* [Basic User_AgriCo]

> *"Changing layout...the IT people explained that it was possible and early on there was a lunchtime [training] session of how to use the Collaboration System. This is one of the features that got mentioned about editing the front page to make it into your own personal view. . They would have showed us an example and briefly where to do the editi*ng." [Intermediate User_CommCo]

"…EnergyCo did formal training basically around the new features and the monitors were mentioned. So he gave us quick run through of how you can set them up and then we went away and set them up so it was specific to our role to the point, now where we've got monitors set up for change management and for the service desk guys - for their cues and stuff…they also gave you a quick overview of some of the reports you can do..." [Advanced User_EnergyCo]

"...I have my own view set up and I have links in that view to the areas that I use the most…[I] took the introduction, the collaboration system Introduction course, even though I'd already played around with it, when I did the course it gave me a lot more information." [Advanced User_CommCo]

4.4.2.2 *Hot Tips*

In addition to on-going training, some participants particularly made mention of 'hot tips' they received on how to use the System, which played a role in facilitating variation. Specifically at AgriCo, some participants related how periodic communications (i.e. whether emails and/or newsletter) from the in-house trainer broadened their knowledge about the IS features, thus triggering and/or enabling variations. Also, 'hot tips' helped participants to keep abreast of changes and/or additions to the IS. In some cases, the communication focused on use of a specific feature, which was helpful to participants as it provided details on the 'know-what' and the 'know-how'. The following quotes are representative of the arguments above:

"Yeah, so would [we] definitely initially had the training with [trainer's name] which was really good and he also sends through emails of how to do things, which is sometimes helpful... Unless we're going to spend every month in the office we'll never get through everything… he [trainer] sends us sort of check note emails, if there's something new he's put into the CRM, which is helpful." [Intermediate User_AgriCo]

"[The trainer]…teaches us the system when there's changes and things, he used to put out a thing called [name of newsletter] - it was just a quick little summary of one task. He might send it out once a week, or whether he came across something that somebody was struggling with he might summarize how that could be done and send that information out to everybody. And that was quite good." *[*Advanced User_AgriCo]

In summary, the findings revealed that IS Support was pivotal in facilitating variations; this included provision of on-going training sessions and 'hot tips' on how to better use the System. Such resources seemingly played a role in individuals' use as they learnt about various aspects of the IS and thus engaged in variations (e.g. using formerly unused features, modifying use of currently used features).

4.4.3 Domain-Related Knowledge

The findings across the three (3) cases revealed that *domain-related knowledge* including knowledge of the features of the IS and work processes were also instrumental in facilitating changes in post-adoption use.

4.4.3.1 *Knowledge of IS features*

Users' knowledge of the system and its functionality also played a role in facilitating variations, and was evident in AgriCo and CommCo. Knowledge of IS Features represents a conceptual understanding of the system components, that is, features of the system (Santhanam, Seligman and Kang, 2007). This included the 'know-what' and 'know-how' elements of IS knowledge. For example, users related:

> *"The whole CRM can seem a little bit daunting with all its different functions and [then] you get that knowledge base- where you can say – what does that do, and why do we do that… And what's our whole reasoning behind using that particular thing [feature] is."* [Advanced User_AgriCo]

> *"Just learning more how to use…I tend to learn how to create views in the CRM and how to create a segment. Also, just learn how to my way around the CRM in different tabs where the different information is kept."* [Intermediate User_AgriCo]

As users gained greater knowledge of the IS, the findings revealed that this provided them with a better understanding of how the System operates. Thus as participants' mastery of the System increased, it provided more opportunities for variations. As one user shared:

> *"Well I suppose that's how I found out that order [feature] and found out it could be quite valuable, just by sitting down and having a flick through, 'cause there is a lot of tabs in there. And just knowing where to find them ... sometimes when you open one tab, there could be another twelve tabs off it, which will give you all different information. Actually understanding what those tabs are gonna do for you I suppose [helped]."* [Basic User_AgriCo]

It was found that as participants gained knowledge on how to use the Systems underwent changes, their understanding the System features increased, providing insights on other features:

"I learnt how to, for example, update my homepage and how to add pieces into your homepage and things like that - knowing that I could do that was good and because a lot of the information on the front page was not stuff that [was very important], well, some of it was okay, you know. But I also wanted it setup in such a way that the things that I wanted to know more was at the top. I didn't need this particular widget or something so I could get rid of it... When opening my page now I know exactly, the stuff that I want to know first is at the top…" [Intermediate User_CommCo]

It was also observed that as participants' knowledge on how to use the Systems increased through interacting with various knowledge sources, this facilitated variations. In other words, variations emerged from knowledge gained through interaction with different sources of knowledge, such as peers, IS Support/Training, as evidenced in Sections 4.4.1 and 4.4.2 above. For example, the case study showed that some participants utilized the IS knowledge acquired from peers or IS Support to perform variations.

"… being buddied next to people, seeing how different people do it and some people prefer the tree, some people prefer to do things other ways ... just by you sitting with other people and seeing how they do it, you can try out the different ways." [Basic User_AgriCo]

"I will get an email from the IT Team outlining what that new function is and usually if it is something reasonably straightforward, then it would just be an email saying this is how it works and this is what you do." [Advanced User_AgriCo]

4.4.3.2 *Work Process Understanding*

Greater understanding of work processes, in regards to one's job role also served as a facilitator of variation. Work process understanding is the extent to which users understand how to perform their own work activities in the IS environment and how their work activities fit into other work processes (Jones, Zmud, & Clark Jr, 2008). Work process understanding as a factor facilitating variation was particularly evident in EnergyCo, as an explicit understanding of the work processes (and/or work-flow) was central to understanding how to use the IS (due to the nature of participants' jobs).

It was found that for some participants, when they learnt more about their respective work processes and others that their tasks fit into, this encouraged them to engage in variations to enable greater synergies between these processes and their use of the IS. For example, as shared by three users below

"There's sort of a work flow diagram you can have a look at - dependencies…You see the different stages graphically. I started using that a lot more to try and understand exactly where it was in the process…So I could start seeing the [picture], what different services relied upon. A request, like what it was actually impacting on, what are the different services and the services in the conflict items...Once I worked out I could actually ascertain it from the tools, it then became quite useful." [Basic User_EnergyCo]

"I really got my head around exactly what went where and how the whole thing fitted in…. Just becoming better at [it]…understanding the relationship between the request and tasks and notes and all that stuff and also just how to use the application…I guess, understanding that process behind it and then being able to apply real life examples- this is how a change happens in the real world and this is how it happens in [ITSM], [that is] understanding where the synergies were" [Intermediate User_EnergyCo]

"...My use has possibly changed [because] I probably better understand why we are doing what we are doing. Where in the past, it was black..." [Intermediate User_EnergyCo]

Thus, as participants' understanding of both the IS and work processes increased, it provided greater insights into 'how to' perform work tasks in the IS and provided a better understanding of how the IS relates to and fits into the various work processes. For example,

"The revenue meters are probably the best example where we documented the flow, because people knew that the meters sit between these two IT systems. What they did was spend time in ITSM updating the Configuration Management Database so that it accurately reflect how they work... so that now you can do a proper stimulated outage, which you can do in ITSM. So if somebody said what are the implications of losing either the meter or the switch that they go to, you can see that properly…it was more just driven by understanding more things about like configuration management and I suppose understanding [the] ITSM." [Intermediate User_EnergyCo]

"... learning by doing. So you start, you go, 'I hate this', ask lots of questions, understand how it fits together and then gradually, once you'd understood a little bit of it you could then go, 'Oh I want to be able to look at some other stuff [in the IS]'" [Intermediate User_EnergyCo]

Furthermore, as some participants came to better understand their work processes (or tasks) in the IS context, it created opportunities for them to engage in variations as they sought to use the IS features to better support their work processes. For example in the quote below, the user shared how a greater understanding of the 'change process' in the context of ITSM facilitated variations,

> "*I think right at the beginning, when I started with the change side of things, I wasn't sure about [the] change [process] myself...I went on a foundation IT course a few months ago. And I think just understanding the foundations, which was outside of ITSM, and seeing how the ITSM works and its set up, you could see that ITSM is based on ISO [International Organization for Standardization] foundation…and [how] the tool that you are using correlates [with the change process].*" [Advanced User_EnergyCo]

In summary, the evidence suggests that greater knowledge of work processes further enabled variations. This suggests that a more holistic view as opposed to a parochial view (of the work/business process relative to one's job role) is of significance in advancing use.

4.4.4 Intrinsic Motivation

> *"I just fiddled with it [the CRM system] until I got it to what I want it to do. At work I'm really conscientious and really a go-getter and pushy, cause I want it to work." [Advanced User]*

Intrinsic motivation is defined as the "doing of an activity for inherent satisfaction rather than for some separable consequence" (Ryan & Deci, 2000a, p. 56). When intrinsically motivated, an individual is moved to act for the fun or challenge entailed rather than because of external prods, pressures, or rewards (Ryan & Deci, 2000a). The findings suggested that individuals, particularly more advanced users, were intrinsically motivated, and thus more resourceful and self-driven to engage and explore the features of the IS. Coupled with a sense of curiosity and a desire to learn and experiment with new features, some participants expanded and modified their use of the IS. As an advanced user related "*I've got quite a desire to use it [the IS].*"

While some participants focused on the bare minimum in terms of feature use, there were others who sought to more than satisfice, engaging in exploratory behaviours because they had the desire and inclination to "*get as much as information as is available*" and use the IS as much as they could:

> *"I'm getting as much as I can out of the system and using it to its maximum I suppose…. if you want to operate it well and look for its full capacity you can, but if you just want to do a basic job with it, it can do that as well… I suppose I like information. I like how it operates, so I try to get in-depth with it. Some people may do just as much as they should do; I like to get as much information as is available."* [Intermediate User_AgriCo]

"*I just like to know what it can do, and if I thought I could actually use it, then I would go and investigate how to use it. But it's nice to know that there is that option available…I think just because I use it every day, all day, and I'm quite happy to investigate how to get something to work for a few minutes where other people just want it to work and (someone to) show them how it is done. So I do know quite a bit about it.*" [Advanced User_EnergyCo]

It was evident that some participants, intrinsically motivated users, had the desire to learn, and thus discovered, explored how features can be applied to support their work. This in turn facilitated variations,

"[Knowledge comes from] just playing around with the system, yep. I'm one of those guys that if you put a system in front of me, I'll go through just about, not every menu, but I'll go through and see, what is this, why don't I know what this does?" [Advanced User_EnergyCo]

"Even if you've never been shown a feature by the boss or trainer, you can probably still find that feature and use it properly. Just a process of elimination and just the desire to want to see if you can find it, as opposed to, 'Oh no, I don't how to find that.' Whereas my personality is more like, it's not like you're going to blow the system up or something if you click on the wrong… It's just different personalities I think and the CRM is designed for personalities like mine... you sort of want to do things properly I guess, or you're inquisitive." [Advanced User_AgriCo]

Consequently, in some instances, some participants independently used a trial-and-error approach through exploration, to find different ways of using the IS. More intrinsically motivated participants seemed to have a '*passion for learning'* aspects of the IS. The following quotes are representative of such:

"Trial and error, if you keep doing something wrong all the time, you will finally work out how to do it right…it's all about hands on experience with it really and using it a lot…the potential always increase because they will upgrade it and then it is capable of doing extra stuff, so its on-going cycle really." [Intermediate User_AgriCo]

"I think that basically it's like anything, its trial and error to a degree, you get to a certain level of familiarity with the system and then for one reason or another you need to know something else, and you don't necessarily know it off the top of your head. At that point it has become kind of a constant learning mechanism of improving and refining" [Advanced User_EnergyCo]

Coupled with an innate desire to learn, intrinsically motivated users tended to engage in self-starting behaviours that further leveraged the features of IS. Such participants were seemingly more persistent, and so were undeterred (or less deterred) by their lack of initial knowledge, or difficulties (or challenges) with the IS,

> *"I'm a nosy bugger and I keep digging ...I've always used diagrams in my documents, in my written documents. I just wanted to find a way of putting them onto the collaboration system. The collaboration system makes putting diagrams on very easy [but] having links there as well [is] very difficult. I just had to keep trying things, if that didn't work have another go and another go, try different things…I'm finding new ways to do things."* [Advanced User_CommCo]

> *"The other technique I've used is to start imposing a sort of a folder structure…. no one tells you to do this stuff, you realize that it needs to be done; there was a drive to achieve this somehow. As to the how - I think there was a bit of experimentation but then just seeing what the system would do and making it work…"* [Advanced User_CommCo]

Furthermore, intrinsic motivation was an important factor that enabled discovery and further use as the system evolved with newly added features:

> *"What I think as a philosophy that's true anyway for anything we're doing, it's just as true for the collaboration system…it continues to evolve. We're on one version of the system now, as the system continues to mature, so the system will be based on another version in few months and so new functionality will come with that. I find if we're just happy with what we've got then it'll just stagnate. It has to keep developing - people need to see new things. So it's important to continue to push how it's going."* [Advanced User_CommCo]

Participants who were apparently intrinsically motivated often engaged in search behaviours and/or frequent learning activities without external prompts for the inherent purpose of engaging more with the IS. This was the case especially for more advanced users.

In closing, the following comments by two participants are representative of intrinsically motivated users and how this characteristic triggered and/or enabled variations,

> *"I just fiddled with it [the CRM system] until I got it to what I want it to do. At work I'm really conscientious and really a go-getter and pushy, cause I want it to work."* [Advanced User_AgriCo]

> *"I think just by nature I like investigating something and trying to figure out how it works. And I'm quite happy to be left alone to do that… I'm quite happy to just sit down and try and figure it myself, before going and ask someone. I will search the Internet, search the help files, and then I will go and ask someone, because I like to figure it out myself. And I also think just by figuring it out myself, I learn about it a lot more, instead of somebody just telling me."* [Advanced User_EnergyCo]

4.4.5 Extrinsic Motivation

"Just for the requirements for the job, you had to learn and had to use it." [User]

The case findings revealed that extrinsic motivation, in the form of management directives, also played a role in facilitating variations. Extrinsic motivation refers to doing an activity for some separable outcome, such as its instrumental value (Ryan & Deci, 2000a). Unlike intrinsic motivation discussed in the previous section, extrinsic motivation shifts the locus of causality for performing variations from internal to external. This factor, that is, extrinsic motivation in the form of directives was only strongly evident in one firm, AgriCo. In particular, at AgriCo, the CRM was used "*as a monitoring tool of how the Account Managers perform"*, and was tied to performance. The CRM system monitored if and how features were used for handling current clients, sales accounts and prospecting for potential clients. Thus the findings are unique to AgriCo, since it was the only case where use of the IS, that is, the CRM was a major evaluation criterion on which users (that is, Account Managers) were assessed.

As such, each Account Manager had an incentive to use the System to support performance. The incentive scheme was based around hard data from the CRM such as how many visits were made to customers of a certain size, and what activities they undertook with customers (e.g. plans, budgets). There was therefore a strong link between the incentive and CRM use, as the CIO highlighted, "*if it's not in the CRM, you can't prove it, so you don't get it [the incentive]*."

Variations were therefore triggered and facilitated through mandates on the use of certain aspects of the System. As one participant recounted "*quite a big one of it [change in use] was actually the requirement by the company... they got quite efficacious about requiring us to do things within it [the CRM] and so it was just for the requirements for the job you had to learn and had to use it."* As managers aligned the use of certain features to performance, individuals readily used previously unused features to meet the mandated requirements. For example, supervisors would access Account Managers' calendars to check whether visiting information (e.g. date, location and time for farm visit) was recorded, and also to verify if visits were made and the outcome of such. Hence, Account

Managers were required to use the calendar to record and document visits, and also as a planning tool:

> *"As our phone technology has gotten better we're able to actually synchronise through the CRM calendar into our phones and PDA's. So you have that calendar there with you and probably about five/six years ago we were told that we were not to use written diaries, it was all to be done through the computer…what we try and do is to be 60% planned for two weeks in advance, so that you know these visits that you've got coming up and if you get an extra phone call from a farmer coming in, you've got that ability of slotting it into that calendar at that time."* [Advanced User_AgriCo]

Users were therefore cognizant of the fact that failure to use certain features would impact their performance assessment. As one user recalled,

> *"I'm a bit from the old school where the sales if they're up there and above budget and everything, well how you get it who gives a hoot?"... I'm more of a diary, a paper person; and that was it, but I realize now that everything has to be put in the CRM system as such, because they [management] run reports and everything. Even if your sales are really good if they can't see what you've been doing to get it [in the CRM]…that's the way they work…"* [Intermediate User_AgriCo]

Specific examples of variations facilitated by extrinsic motivation include,

> *"The calendar…I wasn't using it all in the beginning but I didn't realize that our performance is measured on that, so once I found that out I worked out how to use the calendar and I keep doing that now."* [Basic User_AgriCo]

> *"Nutrient budget [feature]….it basically tells us what nutrients that farm needs and then we put those into a fertilizer plan. So every farm is required to have a nutrient budget - every dairy farm…Just more documentation on the farm really…we had to do them, so that wasn't from the start, but has come in later."* [Intermediate User_AgriCo]

> *"I started using the quote tab, so you can keep an eye on who is ringing the Customer Centre to get quotes on products. So you're using it as a sales tool because it sort of alerts you to who is wanting prices on different products when they may not have rung directly, so they ring the Customer Centre…the boss said to me to start checking the quote tab. So it was sort of a directive really, rather than I just stumbled on it."* [Advanced User_AgriCo]

Some participants were sceptical about management's use of the CRM to monitor their performance. For example, a participant remarked, "*it was a bit of a concern...and the concern was not that they were monitoring it but that they were making assumptions about things."* However, despite concerns, extrinsic motivation, in the form of management directives, brought about and initiated changes in the use of System features.

> *"Yea, it makes you use it more because a lot of the way they measure you is in your use of CRM, so you do use it a lot…a lot of the measurements on sales and also customer contact and they* [management] *run reports if we contact anyone, who we may not have contacted in the last 3 months…[so] management uses that to monitor what we are doing and that's all done through the CRM."* [Intermediate User_AgriCo]

4.5 Inhibitors of Variations

Users' lack of knowledge and training issues were identified as the main inhibitors of variations for some interviewees, which are discussed below.

4.5.1 Lack of (or limited) knowledge

"I still don't know a hell of a lot more on the CRM. There's a lot of information in there that we can use that we don't really get taught" [User]

The most common inhibitor found across all three (3) firms was lack of (or limited) knowledge of the available IS features. The findings suggested that some users had limited knowledge of the available IS features. As one user related "*I don't know what's in there [the System]. It's like my cell phone; I don't know what my phone can do. I text and I make calls, but I'm sure if it can do other things; I don't know what it can do."* [Intermediate User_AgriCo]

Limited knowledge of the capabilities of the IS feature seemed to be a deterrent to performing variations, particularly for basic users, as one participant recounted *"I've probably used about 2% of what the tool could be used for use it more. Probably better understanding of the tool [would help]…so the big sort of inhibitor was the fact that I just didn't really need to use it for more than what I was."* [Basic User_EnergyCo]

An observation specifically at CommCo was that some participants failed to embrace the Collaboration System (and thus perform variations) partly because they were seemingly unaware of the overall purpose and/or capabilities of the System. Some participants, particularly basic users, perceived the Collaboration System as a type of social networking application to support their work, and not as a full-fledge Information System, and hence limited their use of the System. Evidence of such is found in the comments below,

> *"Well I think when the Collaboration System first went live, I think there was a desire to make it quite [like] a social media…I use the computer for my job and that's about it…I'm not really somebody who mucks about on computers all the time. So I don't know that if we improved the resource and that it would actually make me use it a lot more…I don't mess about in the collaboration system."* [Basic User_CommCo]

> *"I mean, if I want to talk to someone I'll just pick up the phone or email them. I don't have to write it on a blog page for every man to see!...I know it's used like a forum -- the blogs; there is other little bits and pieces that people use on it but I don't go on it...I don't know how they do that."* [Basic User_CommCo]

Some participants also viewed the Collaboration System as simply an IS to store and retrieve documents, which reduced the possibilities of variations,

> *"[When I just started]...there was no structured introduction. It was more - this is our hub and this is another repository as opposed to a P-drive. Some of the technology side of the business use the P-drive and [in] the marketing area it's the O-drive or the R-drive, and it was introduced as an alternative to these drives""* [Intermediate User_CommCo]

In summary, limited 'know-what', 'know-how' or 'how-to' knowledge of the IS features was a key inhibitor for some users, and minimized their interaction with the IS, thus reducing variations. This included limited knowledge of the available features, limited understanding of the 'bigger picture of what the IS can do', and lack of understanding of how to apply known features.

4.5.2 Training Issues

Findings from the cases revealed that two aspects related to training were also inhibitors to performing variations: (i) limited on-going training and (ii) the scope of the training.

4.5.2.1 *Limited on-going training*

Although users were trained initially on the "*fundamentals"* of the IS, some participants remarked that on-going training would be of value in furthering their use of the IS, stating *"there may well have been elements of the tool I just wasn't trained in…So maybe if they had been more training, I might have seen other areas of the tool that I could have utilized..."* [Basic User_EnergyCo]. Some participants also noted that on-going training would provide a forum to ask follow up questions, as one user shared, *"I guess, what would have worked better is if you get the application, you then go, 'I* *need more training', And then have a two hour session on - right now you've seen it and you've got used to how it works, these are the answers that are relevant to the questions you have [this], would have been a better training format*." [Intermediate User_EnergyCo]

In addition, another user related that changes in the IS (e.g. addition of new features) were not followed up with training, hence limiting users' ability to become familiar with and use the new aspects of the IS. For example, a user related "*over the next year, it [the system] was changed repeatedly as they tuned in and those changes weren't communicated it that well. An email would just come out [to say] and you are doing this now*." [Basic User_EnergyCo]

4.5.2.2 *Scope of the training*

For some participants, the wide scope of the training (i.e. too many areas or topics covered) was also an inhibitor, that is, training was not specific to particular job roles. For instance, a user recounted, "*It [the training] gave me the tools I needed to do the job. It wasn't a first class piece of training. Basically it went into too much detail and not enough practical stuff…and not actually focussed on the common day-to-day tasks."* [Basic User_EnergyCo]

Another issue was that the training sessions lacked details on 'how to' use particular features. For example, a user remarked that the training focused on "*how it [the system] works",* as opposed to *"this is want you would be doing."* Another user who shared similar arguments expressed "*while the training was comprehensive [and] good in the sense of this how the tool works. It wasn't good for us, cause it didn't tell us how we were expected to use. So it was like here how the tool works… but it didn't give you – here's what we want you to do with"* [Basic User_EnergyCo]. In the same breath, too many details can be off-putting, as one user quipped, "*After half-day training course on an application…it was like 'kill me now.'*"

In summary, the case findings revealed that there were calls for additional training sessions (that is, on-going training), which would be instrumental for "*going over things again, just to refresh and be shown some little things*". However, lack of on-going training was not the only factor inhibiting variation; but the scope of the training was a factor also:

> *"…More training, proper training probably would have been better…not just giving you a brief overlay of what it can do; they needed to show you where you went to find some of the features and explain to you what they can do. And if you don't use like a blog page or things like that with your job… it means nothing to me. I wouldn't have a clue what you go [for a blog page]…Maybe if I was trained differently and I knew more about it, it might be a bit better to use."* [Basic User_CommCo]

4.6 Selection

Variations provide the raw materials for selective systems to operate on. Selection therefore represents a process of elimination, that is, a process through which some variants are chosen and others are rejected. In the context of this case, it represents a decision that must be made about whether to select a particular feature for use.

In most instances, the case findings revealed that participants' choices were governed by selectively choosing features that leveraged the synergies offered by the fit between task(s) and IS. Thus, participants selected features that seemed likely to produce the purported purpose or meet one's objectives.

After participants experimented with a variation (e.g. using a formerly unused feature, modifying use of currently used features), there was a tendency for individuals to select features that were seemingly of value, as one participant highlighted, "*if you do see a new feature or function see what it does. And from that, you can determine whether it is of any help to you or not*." In a more specific example from AgriCo, a user wanted to create "*standard letters and then attach that to a group of people so that each letter gets individually personalized*", and on being introduced to the Mail Merge features in the IS, she recounted that she "*saw the increased opportunity with our own district"* as it can "*make communication our customers quicker*." Hence, for some participants, selection was governed by the benefits the feature seemed to offer, as illustrated in the example below:

> *"Like monitoring, I set up a lot more monitoring so I know where everything is, instead of having to enter the number and see where it is. I can just set up monitors and so I know exactly where it is in the process if I have to chase it. Instead of having to click on the request, and then click on another button to see where it is in the workflow, and then double click on that to see who's got it."* [Advanced User_EnergyCo]

In selecting, individuals would sometimes choose one alternate method over others for performing a task. In doing so, most participants tended to favor the variation that provided a satisfactory and/or more efficient way of doing their job. For example,

> *"I had another Excel sheet, so I knew where the customers lived. So I was just doing that in my head. I'd say, well if I'm going to Fairlie, then he's up there and he's up there, so I would ring them and try and see them at the same time. Whereas if you do it through the CRM system, you don't have to think about it really, you just click a button and they all pop up [for the region]."* [Basic User_AgriCo]

" I would be looking for something and what they have there wasn't quite fitting what I was looking for. So I just change it, or find a way to change it…so if I'm looking for some dairy farmers who buy lots of fertilizers, I could look them up very quickly. Or if I want to send a letter out to a certain group of farmers, it is easy. You know you don't have [expend effort] to go through the list of people. You can narrow down your prospects or the people you want to target very quickly [*by customizing searches].*" [Advanced User_AgriCo]

In another example, the user reflected on his/her decision of whether to use the 'groups' or 'spaces' features to manage publications within the Collaboration System, selecting the option that provided a relative advantage with respect to the task at hand,

"I tend to rather spaces than groups, because [for] groups you need to manage the invitations. So if you're creating a group and they've only got limited access, only the people that you've invited to that group have got access. And you're also reliant on them to actually become a member of that group as well and actually accept email notifications when you actually post something. I mean I guess it's the same with a space, but at least a space is more open…whereas with a group you've actually invited them, so you actually need them to go in, accept the invitation and then you need them to read the content each time, it's a bit more limited." [EnergyCo_Intermediate User]

At AgriCo, the findings revealed that for some participants, selection was based on conformity, that is, the need conform to norms and rules of the department and/or organization. In essence, the selection was based on external regulations. For example,

"I was using an Outlook calendar that I was used to and that's fine. I know how to use it and it's good, but I need to use the CRM calendar, so that my employer can see what I'm doing. Because he doesn't look at the Outlook calendar for that [monitoring]. It's all integrated, recording and so on in the CRM." [Basic User_AgriCo]

"*It doesn't matter, it [use of GPS feature] has to be done…it just seemed extremely overly complicated…actually it hasn't saved any time."* [Advanced User_AgriCo]

There were also instances where participants may not select a variant, if the relevance and applicability was not appreciated or it did not meet an immediate need. As commented by two users:

> *"... although we'd all been shown how to use it [feature] initially, some of us perhaps at the time didn't see the relevance.... it wasn't something that was needed. You didn't have to do it for your customers to be able to do a fertilizer recommendation."* [Advanced User_AgriCo]

> *"If I like the way I do something and if it works, then I don't want to change it. And if somebody is forcing me to change it, I'm going to keep on doing it my way, or unless they can prove that it is best doing it another way, I am just going to keep on doing it my way."* [Advanced User_EnergyCo]

In summary, in the process of elimination, most participants selected the variations that best suited their needs and resulted in greater efficiencies. Basically, they considered the objective value of the feature, that is, the benefit of using a particular feature to enact their work routine. As a user reflected in his story of use, "*It's all down to 'can you see a benefit in doing it?'"* Even in instances where the criterion for selection was conformity, the benefits and/or value of the feature were still sought. For instance one user enquired of his manager *"We don't need that, why...do we need that? Then he'll explain why... [and then] very rarely is it a pointless thing".* Thus, in most cases, selection was determined by "w*hether it will help in your every day job, if you see a use for it."*

4.7 Retention

Retention occurs when individuals turn a variation into part of the story (Feldman and Pentland 2003) about how they perform their tasks. With retention, the outcome was continued use of the particular feature(s), and as a result, the variation became a part of their work routine and was thus used to support their tasks.

It was found that individuals retained a variation, if they were *satisfied* with the outcome, that is, it produced value, efficiencies, and met their intended goal (s), thus confirming their expectation. For instance, as one user recounted, "*things [features] where I could add value like that I tended to use a fair bit*." Another noted, "*I felt if it [the feature] was useful then I'll keep using it."*

Reasons that participants gave for continued use of a feature (that is, retention) included, '*easier to manage information*', '*makes it more efficient*', '*finding it that was of value*', '*helps me with my job*', '*it's really good, it really works*', '*easier' and 'simpler',* '*it was just faster*', '*more structured and accountable',* '*it's useful*', '*convenien*t', '*most effective*', '*quite good*', '*works well',* '*it's definitely catered to my interest*.'

Thus, individuals' decisions to retain or keep a feature were guided by whether or not it achieved the desired outcome at a satisfactory level (at best). If the participants were satisfied with the variation after trying it, then the feature is retained.

4.8 Outcome of Change: Deeper Use

This study revealed that as IS use changed over time, by way of retention, it resulted in deeper levels of use, where deep use makes greater use of the features of an IS to support their work (Schwarz, 2003). One key example of deep use that emerged from the findings was infusion. Infusion refers to the process of embedding the IT a deeply and comprehensively with an individual's work system (Saga & Zmud, 1994). Participants alluded to "*using it [the System] to its maximum*" or "*full capability*" as a result of changing their use, which suggested that infusion emerged from incorporating changes they had made into their work routine. Thus, infusion was a suitable term to describe of deep use that resulted for some individuals as they changed the way they used the IS. Sample quotes include:

> *"I'm getting as much as I can out of the system and using it to its maximum I suppose. I don't think there are many other things I can use the system to do now…. It's a bit like an Excel spreadsheet, 99% of the people that use Excel spreadsheet use about 1% of its capabilities. And for us, I actually use it, I get a bit more in-depth than most people, but a lot of people are only using a fraction of what it is mostly capable of, that's people in my position as an Account Manager."* [Intermediate User_AgriCo]

> *"I think I use it pretty much to its full capability, but realizing it does lots of other things that are out of my scope"* [Intermediate User_EnergyCo]

Infusion can occur through a number of ways, for example, it can come about through extended use, integrative use and emergent use (Saga and Zmud, 1994). Extended use refers to using more of the IS features to accomplish a more comprehensive set of work tasks (Saga and Zmud, 1994). By way of retention, some participants used more of the IS features in their work routine, thus expanding their scope of use and exhibiting extended use. For example,

> *"I guess I understand what certain aspects of the programme mean so I use more – like there's lots you can do with the programme so I use more of it than I used to."* [Advanced User_AgriCo]

> *"I use more features of the CRM now, 'cause when I first started I wouldn't have created fertilizer plans or monitored campaigns, or monitored accounts with it; like when I*

started it was basically the orders goes in and that was about it. Now, I use far more features." [Advanced User_AgriCo]

Furthermore, retention also resulted in more integrative use. Integrative use refers to using the IS to establish or enhance workflow linkages among a set of work tasks (Saga & Zmud, 1994). The findings revealed that some participants increased the interconnectedness among their work tasks, creating and enhancing linkages among diverse work tasks. For example, in the quote below, a user shared how the CRM is now being used in a more integrated manner to handle clients' call (in the call center), so as to better understand the client (while on the phone):

"I'm obviously a lot more proficient in it...I'm actually using the system [and] going into things, checking things while we're talking...I'm going into places and using all these tabs [points to the screen], and to see what kind of farm type he is, and like say you go into…'Farm Info' and say he's a sheep farmer. So say he popped up ... we got talking about what was happening, and he goes "Yeah we're currently lambing." And so nothing's popped up about the new [product name], it's a sheep drench, so I go and have a quick look and sort of see what he's got in, and these sorts of thing….sort of navigating around to get a better picture of who he is." [Intermediate User_AgriCo]

The findings also revealed that there were instances of emergent use where individuals used the IS to accomplish work tasks that were not feasible or recognized prior to the application of the IS within one's work system (Saga & Zmud, 1994). For example, at AgriCo prior to the CRM, users were previously unable to track and follow up quotes, but with the IS, as one user commented, "*we've got a view now so you can see your quotes. So we'd have a look at our open quotes and they'd pre-populate down and I'd use this feature to call back the customers and say, "I've given you a price for this. Would you like to buy some?" And that's something that we didn't do when I first started, we didn't have that.*" [Intermediate User_AgriCo]

In summary, through retaining variations (such as trying new features, refining use of currently used features, feature substitution and innovative use of various features), some participants' use of the IS deepened over time. Thus, deeper use of the IS (that is, infusion) came about when users made greater use of the features of an IS by modifying their routines, which resulted in them using more of the IS features (extended use), using the IS to enhance linkages among work tasks (integrative use) and/or using the technology to accomplish tasks that were not feasible before the introduction of the IS (emergent use). By embedding changes in IS use into their work routine, in most instances, this resulted in a new equilibrium and/or status quo in post-adoption use, that is, a higher level of IS use.

4.9 Summary of Findings

This chapter used Generalized Darwinism, that is, the principles of variation, selection and retention, as a lens to understand changes in IS use. Table 4.1 summarizes the case study findings showing the differences between the user types (i.e. basic, intermediate and advanced users) within and across the three (3) organizations. As a guide 'Y' indicates there was evidence of the factor in the case findings, while '--' means that the factor was not evident in the case, that is, it was not mentioned or discussed by the study participants.

Table 4.1 Summary of Findings across cases

	AgriCo			**EnergyCo**			**CommCo**		
	B	I	A	B	I	A	B	I	A
Variations									
Using formerly unused (available) features	Y	Y	Y	Y	Y	Y	Y	Y	Y
Modifying use of currently used set of features	Y	Y	Y	Y	Y	Y	Y	Y	Y
Substituting or replacing one (already-used) feature with another feature	Y	Y	Y	Y	Y	Y	Y	Y	Y
Finding novel or innovative uses of IS features	--	--	Y	--	--	Y	--	--	Y
Enablers									
Peer learning	Y	Y	Y	Y	Y	Y	Y	Y	Y
IS Support	Y	Y	Y	Y	Y	Y	--	Y	Y
Knowledge of IS features	Y	Y	Y	--	--	--	--	Y	Y
Knowledge of the work processes	--	--	--	--	Y	Y	--	--	--
Intrinsic motivation	--	Y	Y	--	Y	Y	--	Y	Y
Extrinsic motivation	Y	Y	--	--	--	--	--	--	--
Inhibitors									
Limited Knowledge	Y	Y	--	Y	Y	--	Y	--	--
Training	--	--	--	Y	Y	--	Y	--	--
Selection	Y	Y	Y	Y	Y	Y	Y	Y	Y
Retention	Y	Y	Y	Y	Y	Y	Y	Y	Y

Key: 'B'- Basic Users; 'I' – Intermediate Users; 'A'- Advanced Users

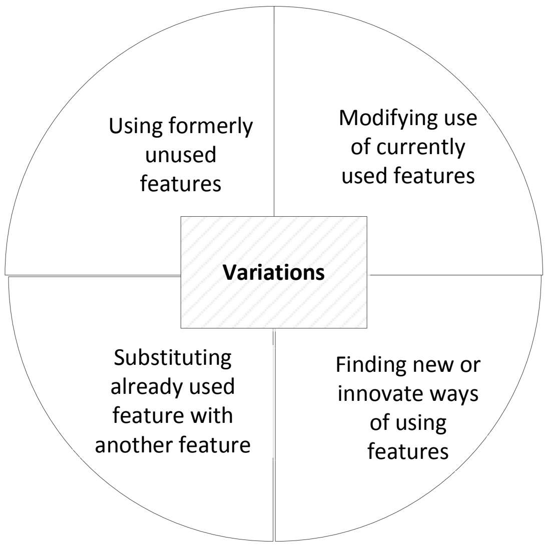
4.9.1 Variation

Variation is often dubbed the 'raw material' for evolution, and is instrumental in the evolution process, as without a rich variation, selection processes have no material to work on (Mayr, 1991). The case findings revealed that variations occurred as individuals experimented with different ways of using the System to support their work. It was found across all the cases, that individuals (whether basic or advanced) engaged in some form of variation, which included (i) *Using formerly unused (available) features,* (ii) *Modifying use of currently used set of features,* (iii) *Substituting or replacing one (already-used) feature with another feature* and (iv) *Finding novel* or innovative uses of IS features. See Figure 4.1.

The finding revealed that u*sing formerly unused (available) features* has a feature exploration focus and involves the use of features that have not been used before. *Modifying use of current features* involved refining and revising use of already used features to improve efficiency and/or outcomes. *Substituting features* included replacing currently used feature(s) with other features with similar functions. Lastly, individuals used features in *new or innovative ways.* Basic, intermediate and advanced users engaged in all forms of variations except finding innovative use of IS features, which was evident only among advanced users. See Table 4.1.

These actions constitute what this research refers to as '*Variations'*, and will be discussed in further detail in the next chapter.

Figure 4.1 Forms of Variation (From Case Studies)



4.9.2 Enablers/Triggers of Variations

Further analysis revealed that the main factors that triggered and/or enabled variations included *Peer learning, IS Support, knowledge of IS features, Work Process Understanding, Intrinsic Motivation and Extrinsic Motivation (through external regulation)*. The findings also suggested that lack of (or limited) knowledge and training issues (e.g. insufficient training) were the main factors that inhibited variations particularly for basic users. Table 4.1 provides a summary of the factors that played a role in facilitating and inhibiting variations for each of the user types within each case and across all three (3) cases.

Learning from Peers served as a key trigger and enabler for variation in use across all cases. Peer learning triggered variation, as it informed users of what features are being used by others. Discussion with peers also encouraged variation, for example, through use of a previously unused feature. Peers in some instances, created opportunities for users to learn new ways (or other ways) to achieve a given task, for example, through peer observation, peer-to-peer training, providing peer-developed documentation and online forums. Thus peer learning in turn, triggered and/or enabled variations.

IS support was also identified as beneficial in encouraging employees to make greater use of the IS in all three (3) firms. The IS staff guided and trained users in the use of the system and were responsive in their dealings with the users. In particular, the provision of ongoing training and hot-tips by IS-staff triggered and/or enabled various forms of variations.

The findings across the three (3) cases revealed that *knowledge of the features* of the IS was also instrumental in facilitating variations. This included knowledge of the 'know-what' and 'know-how' in relation to the IS features. On the other hand, *work process understanding* as a facilitator was only evident in EnergyCo. The findings suggested that as individuals developed a greater understanding of their work processes and how they interrelate, which triggered and/or enabled variations.

The study also showed that *intrinsic motivation* was a key factor facilitating variations across all three (3) firms, particularly when variations are voluntary. This was evident particularly among more advanced users who were more self-driven in their learning, seeking out new and different ways to use the system in their work and to overcome obstacles to use (which are characteristic of persons who are more intrinsically motivated). The findings suggested that intrinsically motivated users were therefore more resourceful and self-driven, willing to explore new options and find new uses of the IS, and more advanced in their use of the IS.

Finally, *extrinsic motivation*, in the form of mandated use or directives from management (e.g. to use specific features of the IS) was also impactful. This served as an external regulator of change and triggered and/or enabled variations, and was particularly salient in AgriCo.

4.9.3 Inhibitors to Variation

Inhibitors can prevent or delay variation; the case study identified two inhibitors - insufficient training and limited knowledge of IS. While training can function as an enabler, inadequate training was a key inhibitor. Some participants revealed that limited on-going training was an issue, and also the wide scope of the training (i.e. too many areas or topics covered) was also an inhibitor, that is, training was not specific to particular job roles. Also, limited knowledge of the available features and how they can be applied to one's job role was an inhibiting factor. At the same time, inhibitors though important, had a lesser impact on constraining use for advanced users than for basic users.

4.9.4 Selection and Retention

Once variations (actions) are introduced, users evaluated the value of those actions and whether the variations were deemed satisfactory in performing a task. These evaluations were then used to guide selection; thus users selectively applied features they considered more likely to yield desired benefits and intended outcomes and rejected those that did not. The findings further revealed that users retained changes in their routines of use if they believed these resulted in greater efficiencies and better support of work tasks and so were satisfied with the variation. *Satisfaction* with new use routines therefore had a strong stabilizing effect on helping to sustain change.

4.9.5 Outcome of Change

Finally, the findings from the case study showed that as IS use changed over time, by way of retention, change towards deeper use was likely to occur as users 'turned a variation into a part of their story' about how they performed their work routines (Feldman & Pentland, 2003); resulted in greater levels of infusion of the IS into their work.

4.10 Chapter Reflection

This study used Generalized Darwinism, that is, the principles of variation, selection and retention as a lens to understand changes in IS use. Variation is often dubbed the 'raw material' for evolution, and is instrumental in the evolution process, as without a rich variation, selection processes have no material to work on. The case findings revealed that variations occurred as individuals experimented with different ways of using the System to support their work, which included use of formerly unused features, modifying use of currently used features (such as improvement or refinement in existing), use of alternate features to perform a task (i.e. substitution of features), or finding new or innovative ways of using the IS. Furthermore, the findings suggested that factors that enabled and/or triggered variations included intrinsic motivation, extrinsic motivation, learning from peers, IS support (e.g. training), and domain-related knowledge. The study also showed that inhibitors, namely, lack of knowledge and insufficient training reduced or delayed variations more so for basic users than for more advanced users. The findings also suggested that variations are more likely to be selected and retained (as exhibited through continued use of the variant), when users are satisfied with variations. In general, the changes made at the individual level resulted in deeper uses of the IS for enhancing work practices.

For Phase 2 (quantitative phase), findings from the case studies together with key themes from the evolutionary perspective of Generalised Darwinism, supporting theories (e.g. motivation theory) and insights from IS research are used to frame the research model for further analysis (Chapter 5). The model will then be tested using data from a field survey and analysed using the PLS approach to structural equation modelling (Chapter 6).

Chapter 5. Hypotheses Development and Research Model

"You may have heard the world is made up of atoms and molecules, but it's really made up of stories. When you sit with an individual that's been here, you can give quantitative data a qualitative overlay."

[William Turner]

5.1 Chapter Overview

Using the tripartite lens of variation, selection and retention, this chapter discusses the case findings in the context of the extant literature, and develops the hypotheses. It uses findings from the case studies together with key themes from the evolutionary perspective of Generalised Darwinism, other supporting theories and insights from IS research to frame the research model for further analysis. This chapter presents two sets of models, and the results reported later in Chapter 6.

The first model (Figure 5.1) is the main model capturing evolutionary change in IS use using findings from the case studies. In essence, the main model examines the effects among the core constructs related to the evolutionary change process that underpins this study (i.e. triggers/enablers/inhibitors, variation, retention, and use-type outcomes).

The second set of models (Figures 5.2 to 5.7) represents the sub-dimensions of particular constructs in the main model, in greater detail. Specifically, using insights from the case findings and the literature, these models detail key sub-dimensions of intrinsic motivation (Figure 5.2), extrinsic motivation (Figure 5.4), domain-related knowledge (Figure 5.5), perceived resources (Figure 5.6), and variation and retention (Figure 5.7). Arguably, although these views may not be considered core to the main model of change in IS use presented in this study (Benbasat & Zmud, 2003) they are useful for providing further insights (both practical and theoretical) into the key constructs being investigated and alternative ways of assessing each of the elaborated constructs in future research.

5.2 Variation

> *"An organism can change the reference involved in the regulation of one of its own behaviors in a number of different ways. It may possess a set of alternative values that can be temporarily activated according to context: a foraging animal, for example, may shift from one search image to another as local conditions change, or an animal's rate of food consumption may change radically when the external temperature drops below a certain level and hibernation begins. It may add a new reference to its repertoire (or lose an old one) by means of learning: the organism acquires a new stimulus–response association, or a new attraction or aversion. If the new reference is different enough from any in its existing repertoire we say that the organism has learned a 'new behavior,' like the birds that learned to use their existing effectors to the novel end of pecking holes in the lids of milk bottles"* (Barker, 2008, p. 13)

Variation is an essential part of the change process, and is often dubbed the 'raw material for evolution', as if there is no variation, there are no alternatives to select from (Mayr, 1991). In a general sense, variation can be defined as "any departure from routine or tradition" (Aldrich, 1999, p. 22), or "where individuals or groups of them generate a set of ideas on how to approach old problems in novel ways or to tackle relatively new challenges" (Zollo & Winter, 2002, p. 343) or the "generation of new ways of doing things" (Furneaux et al., 2010, p. 4). In essence, variation can be defined as change from current routines (Aldrich, 1999). In the context of this research, variation introduces alternatives in how the IS can be used to accomplish work routines.

The case findings in Chapter 4 showed that actions situated within variations included: (i) *Using formerly unused (available) features,* (ii) *Modifying use of currently used set of features,* (iii) *Substituting or replacing one (already-used) feature with another feature* and (iv) *Finding novel* or innovative uses of IS features.

Using formerly unused (available) features involves the use of features that have not been used before. A similar concept in prior research is feature exploration (Ke et al., 2013) and trying new features (Sun, 2012). *Modifying the use of currently used set of features* involved changes in the way the feature was used which included 'fine-tuning' and revising the current use of features to improve efficiency and outcomes. The latter are similar to concepts of refinement (Levinthal & March, 1981) and exploitation (March, 1991). *Substituting features* refers to replacing currently used feature(s) with other features with similar functions (Sun, 2012). *Innovating with the IS* relates to finding new uses or especially innovative (i.e. very unusual) ways of using IS features (Ahuja & Thatcher, 2005). As users engaged in variations, they inherently re-conceptualized their work processes to accommodate the IS. This included the creation and modification of work processes (Orlikowski, 2000).

Collectively, considering these varieties in use, this study defines '*Variations*' as '*experiments with* (i) *different ways of using the System features to support one's work and/or* (ii) *different ways to do one's work to accommodate the System.'*

This research therefore examines variations in both use of the IS features and of work processes. In most cases, use of an IS is task-centric and the features are tied to performing work processes (Saeed & Abdinnour, 2013), and thus it is essential to consider both the IS and the work processes when examining use and consequently change in use. For the IS to be assimilated, users should over time appropriate it to their own ends by absorbing it in their everyday work practices and adapting features and work processes as may be needed (Swanson, 2002). Thus, for success in IS use, it is pivotal that users selectively appropriate IS features for their work tasks and/or alter their work processes to accommodate the IS (Ke et al., 2013).

5.2.1 Experimenting with different ways of using System features to support one's work

Post-adoptive behavior can involve a myriad of actions, as individuals adjust their use of IS features over time. Based on the case findings, variations in relation to adjustments in System feature use include: (i) *Using formerly unused (available) features,* (ii) *Modifying use of currently used set of features,* (iii) *Substituting or replacing one (already-used) feature with another feature* and (iv) *Finding novel or innovative uses of IS features.* These behaviours contribute to the generation of variations, which is central to the theme of change in IS use and the conceptualizations of variation and retention behaviours (that is, constructs) that are central to the research model. These behaviours are discussed below in light of the case findings and the extant literature.

5.2.1.1 *Using formerly unused (available) features*

Using formerly unused (available) features encapsulates the use of additional/new features that were provided by system designers/implementers (Hsieh & Robert, 2006) but were not previously used by the individual. Use of formerly unused features was evidenced in participants' actions, for example:

> *"After using the CRM for a few months, I noticed that when you are placing an order there's a tab at the back called 'cc instructions' and under that they have a list of all the transporters that the customer has used and the number of clients. So you can see who they normally have as the transporter on their order and that's quite handy… [In any case I] clicked on it and then noticed that there was all these transporters there."* [Advanced User_CSR]

Such variations (use of formerly unused features) can be regarded as a type of exploratory behavior, where the user engages with a new feature of the IS (Sun, 2012). Through such behavior, it allows individuals to try out and subsequently use additional features to accommodate a more comprehensive set of work tasks (Saga & Zmud, 1994). Thus, this form of use encapsulates a subset of variations, as it involves a different trajectory in applying the IS, by attempts to use more features of the IS to support a set of work tasks (Hsieh & Robert, 2006).

5.2.1.2 *Modifying use of currently used set of features*

Modifying use of a currently used set of features was a form of variation that was evident in the case findings. In most instances, modifications resulted in the use of features in an improved or sophisticated manner and/or at a higher level of use (Bagayogo, Lapointe, & Bassellier, 2010; Jasperson et al., 2005). An example of modifications from the case findings include:

> *"Special mix…we can do a mix and add to our favourites. So for years, I never used to do this. Say if the customers, quite a few customers would use the same mix and I would manually put it in each time but then I found out we could save it to our favourites list and I could add it without having to add every product…"* [Intermediate User]

Although modifications may not always result in 'better' use, in a rational context, engaging in modifications is presumed to stem from a desire to augment and/or refine existing ways of doing things (Orlikowski, 2000). For example, an ERP system may have features for (i) tracking the movement of inventory and (ii) producing a business intelligence report from the inventory data (Bagayogo et al., 2010). These two features (i and ii) when used together are arguably used at a higher level of sophistication, as in addition to tracking inventory, the output also becomes an input for business intelligence reporting.

Modifications can also include combining features, that is, using features together for the first time (Sun, 2012). As such, variations may also arise as users combine features with which they are already familiar with to create new functionalities (Sun, 2012). Users can also 'mix and match' components (Rice & Rogers, 1980), as they tweak and apply workarounds by using new or already used features to accomplish tasks (Sun, 2012). Another aspect of modification can also include customizations, where users modify pre-defined user options to meet specific needs, thus making it more suitable for effective and efficient conduct of work practices (Desouza et al., 2007).

5.2.1.3 *Substituting or replacing one (already-used) feature with another feature*

Substitution encapsulates replacing a feature that one currently uses with another feature that can perform a similar function (Sun, 2012). This can occur as users search for an alternative feature that is considered ‘superior’ in comparison (Parthasarathy & Bhattacherjee, 1998; Sun, 2012). An example of substitution evidenced in the case findings is shown below:

> *“ When I started using the CRM, we’ve got the tabs sort of on the main screen and then we have also got those sorts of tabs that are in the tree, down the side. And some people prefer the tab, some people like the tree and I was definitely a tab person when I started. But now, sometimes the tree is easier and faster or a better way of looking up, like if you are trying to find an old order or something like that. So that’s one thing that I have changed.”* [Advanced User]

According to Sun (2012), feature substitution can occur physically and/or psychologically. Physical substitution means that the replaced feature(s) is no longer available for use, that is, it is not accessible through the IS (Sun, 2012). On the other hand, psychological substitution means that although the feature is still accessible through the IS, the user does not rely on the replaced feature any longer. Feature substitution therefore does not imply that the user completely discards the feature from the set that they use, as the user may revert to the formerly used feature, for example, if it is considered helpful at a later time or if external factors compel them to go back to the previously used feature (Sun, 2012).

5.2.1.4 *Using features in a new or innovative way*

Over time users may explore new ways of applying the IS in their work (Nambisan, Agarwal, & Tanniru, 1999; Swanson, 2002). This form of variation can include the implementation of novel and useful ways of employing one or more features of a system to perform a task (Amabile, 1996; Mills & Chin, 2007). For example, a user described how she suggested and implemented a modification of the ‘forward schedule feature of the System (ITSM) to extend the functionalities of the ‘work calendar’

> *“...as an example the forward schedule of change that is our calendar of upcoming work is connected into the tool, that’s color coded by the task. I did do a review and change of that a while back so it was clear on the calendar…what’s the status of work we are sitting at, which I think has been quite useful in general. Anyone opening that schedule will have access to and be able to see...”* [Advanced User]

The notion of novel and/or innovative use is present in the IS literature with related concepts such as emergent use (Saga & Zmud, 1994), intention to explore (Nambisan et al., 1999), trying to innovate (Li, Hsieh, & Rai, 2013), creative use (Mills & Chin, 2007), and innovative use (Li et al., 2013). Uses of this nature creates variation, as users apply the IS features in novel and non-routine ways to accomplish his or her work tasks, which may go beyond standardized ways of applying the IS (Li et al., 2013).

5.2.2 Experimenting with different ways to do one's work (work process) to accommodate the IS

Technologies are embedded within users' work processes, and thus adaptations may not always occur to the technology per se (i.e. feature use), but can occur to the rules and standards related to how the technology is used (Desouza et al., 2007). When an organization implements an IS, it is likely that users may have already formed habitual ways of performing their tasks that conflict with the processes and goals implied by the new system (Polites, 2009). Nevertheless, Information Systems (e.g. ERP) may then interrupt established patterns of behavior and cause work processes to change to accommodate the IS (Jones et al., 2008).

It should be noted that the interviewees, from the case findings, did not explicitly separate variations in feature use from those made to work processes to accommodate the IS. However, although not directly evidenced in the case findings, the extant literature suggests that explicit adaptations to work processes may include individuals creating, modifying and refining work processes to more fully integrate the IS into their work practices (Majchrzak, Rice, Malhotra, King, & Ba, 2000; Orlikowski, 2000). Thus, changes in work processes to accommodate the IS is explicitly considered in this study as a type of variation.

Such changes in use are supported by the IS literature, which suggests that over time users can modify and redesign their work process, and by extension the manner in which they interact with the IS (Boudreau, 2005). Users can thus in applying the IS improve or enhance their existing work processes in enacting their work tasks (Orlikowski, 2000). For example, Sproull and Kiesler (1992) described how a communication technology changed the way individuals work within an organization, resulting in the creation of better products. In another example, Majchrzak, Rice, Malhotra, King and Ba (2000) described the case of a computer-supported inter-organizational virtual team, where the team modified their work processes over time, as the emergent task demanded a different set of aligned structures.

In concluding, this section discussed the different forms of variations identified in the case studies and in light of the IS literature. Variations, as noted earlier, are defined in relation to modifications in the use of System features to support one's work and the work processes to accommodate the IS. For example, the literature purports that individuals can re-conceptualize their work processes to fit with more uses of the IS (Fadel, 2012) and also modify their use of various features (Jasperson et al., 2005; Sun, 2012). Such actions together with changes in the use of the IS (e.g. using new features, substitutions) in turn generate the varieties needed for variation to occur (that is, the first step for change), and referred to in this study in defining and operationalizing the notion of variation, retention as captured in the research model (Figure 5.1).

5.3 Enablers and Inhibitors of Variations

> *"Dogs like the flavor of cheese; that is, the flavor of cheese is close to some reference that dogs use in selecting food. Humans can take advantage of this fact about dogs in several different ways. If I want to get a dog to jump up in the air, I can do so by holding a piece of cheese in the right place above the dog's head. If I want to train a dog to perform some particular behavior (jumping on command, say) I can do so by using cheese as a ''reward'': the dog adds a new sub-reference to those it employs in regulating food intake, a new way of getting the food it prefers. If I want to get a dog to like me, and so ultimately (for example) to be willing to learn new commands from me quickly, willing to take risks to protect me, etc., giving it a lot of pieces of cheese (under particular conditions) is not a bad way to start. Moreover, if I want to pick out the dogs that are the easiest to get to jump, those that can jump highest, those that learn commands most quickly, or those that make friends most easily, I can do so with the help of a lot of bits of cheese."* (Barker, 2008, pp. 18-19).

Despite the usefulness of an evolutionary framework for describing change, it fails to account for the processes that lead to the introduction of variations (Ford, 1996). This section therefore discusses and states the hypotheses for the antecedents put forward in the research model as they relate to the triggering and/or enabling of *variations*, based on the literature and evidence from the case studies as detailed in Chapter 4.

5.3.1 Intrinsic Motivation

Intrinsic motivation can be defined as the "doing of an activity for inherent satisfaction rather than for some separable consequence" (Ryan & Deci, 2000a, p. 56). The case study findings (Section 4.4.4) suggested that intrinsic motivation was a particularly salient enabler of variations, particularly when extending one's use of the IS is voluntary. As one user noted, "*I just fiddled with it [the System] until I got it to what I want it to do. At work I'm really conscientious and really a go-getter and pushy, cause I want it to work.*" Another user commented, *"If you do see a new feature or function,* [there is] *a bit of curiosity, so you click on it and see what it does*." These are consistent with prior research which suggests that intrinsically motivated individuals are more likely to partake in proactive engage with system features (Li et al., 2013). Intrinsic motivation encourages exploration, persistence, flexibility, spontaneity, and behaviors such as creativity (Dewett, 2007). Users who are intrinsically motivation tend to actively explore the IS and seek to discover innovative ways of applying the system to best support their daily job tasks (Ke et al., 2013).

Furthermore, the case findings suggested that advanced users in particular were more self-driven in their learning, seeking out new and different ways to use the system in their work and to overcome obstacles to use (which are characteristic of persons who are intrinsically motivated). Such findings are consistent with prior research which suggests that intrinsically motivated individuals are more likely to expend energy exploring the IS (Cooper & Jayatilaka, 2006). The 'labour of love aspect' driving human behaviour (i.e. intrinsic motivation) (Amabile, 1997) drives individuals to expend intensive effort on performing work tasks (Ke et al., 2013). Arising from within, intrinsically motivated users also tend to perform extra roles volitionally, that go beyond their customary job duties (Van Dyne, Cummings, & Parks, 1995), and are more likely to voluntarily experiment with new aspects of the IS (Li et al., 2013).

In essence, intrinsically motivated individuals are more likely to partake in proactive exploration of system features by altering their work processes and feature use (Ke et al., 2013). Hence, it is suggested that:

H1: Intrinsic motivation is positively associated with Variations

5.3.2 Extrinsic Motivation

Extrinsic motivation refers to doing an activity for some separable outcome, such as its instrumental value (Ryan & Deci, 2000a). It entails a cognitive assessment of an activity as a means to an extrinsic end (Amabile, Hill, Hennessey, & Tighe, 1994). Some individuals are more motivated to do an activity primarily in response to something apart from the activity itself, that is, for external inducements, such as reward or recognition or the dictates of other people (Amabile et al., 1994).

Findings from the case studies (Section 4.4.5) showed that extrinsic motivators were largely evident in the form of mandated use or directives from management (e.g. to use specific features of the IS). These served as *external regulators* of change and triggered variations. For example, a user remarked "*they* [management] *got quite efficacious about requiring us to do things within it.., so just for the requirements for the job you had to learn and had to use it* [the System]."

Changes in system use can be triggered when an individual is requested to do (Sun, 2012). As such an individual may try to use new features or use known features in a different way when given a deliberate initiative, that is, they are asked explicitly to do such (Sun, 2012). In mandatory settings, for instance, a superior may require an individual to use particular aspects of the IS, or in some cases individuals may selectively use features when they believe that they are being monitored (Hartwick

& Barki, 1994). Louis and Sutton (1991) suggest that conscious processing can occur when individuals are induced to deliberate regarding their behavior, thus switching gears between habitual and active thinking. By way of active thinking, this may serve as a precursor for active use behavior in post-adoption (Jasperson et al., 2005). Consequently, deliberate initiatives, as a form of extrinsic motivation, can possibly give rise to adaptive system use behaviors, such as trying new features, feature substituting through active cognitive processing (Sun, 2012). It is thus suggested that extrinsic motivation, for example through management directives can encourage users to deviate from habitual system use (Sun, 2012), and engage in variations. Hence it is hypothesized that:

H2: Extrinsic motivation is positively associated with Variations

5.3.3 Peer Learning

Learning from peers was another key trigger and enabler of variations based on the findings from the cases (See Section 4.4.1). The results suggest that peer learning can improve individuals' use of an IS and enrich ones' skills and ability to further leverage the features of the IS. Especially for task-specific uses (Ryu, Kim, Chaudhury, & Rao, 2005), peers were one of the key sources of ideas and encouragers of variations. As a user shared in the interviews, "*you pick up from your co-workers"* as *"there may be using a particular function that you are not using and they show it to you."* Similarly, another user recounted, "*I think that all of us are inclined to use the same tool in slightly different ways, so when that happens there is bound to be the odd occasion when someone has a slightly different experience and that can trigger some kind of learning."*

Peers can serve as an intervention source that helps to reshape existing cognitions regarding IT application features of other organizational members (Jasperson et al., 2005). Peers can also aid in fostering change, as they can encourage individuals to apply unused features, to apply already-used features at higher levels of use, to discover more efficient ways of using the system, to find new uses of existing features or to identify the need to incorporate new features into the IS (Jasperson et al., 2005; Papa & Papa, 1992).

Prior research suggests that peer learning is important in facilitating use, and has a strong impact in both the initial and advanced stages of IS usage (Saeed & Abdinnour, 2013). As individuals' use of an IS evolves, peers (colleagues or subordinate) can be instrumental in helping them to navigate the IS (Bullen & Bennett, 1991). Peers can also aid individuals to overcome knowledge barriers that tend to constrain use of Complex Information Systems (Sykes, Venkatesh, & Gosain, 2009). Furthermore, research has shown that users tend to rely on peer and/or colleagues for assistance in using less familiar features and advanced features of the IS (Fulk, 1993). As users learn how to use a system, they interact with each other and exchange information, which can help them to adapt to new ways of performing their tasks and/or clarify their understanding of how to perform tasks (Papa & Papa, 1992). Hence, it is suggested that:

H3: Peer learning is positively associated with Variations

5.3.4 Domain-related Knowledge

Domain-related knowledge in this study includes knowledge of the (i) *features of the IS* and of (ii) *work processes*; the case findings revealed such knowledge facilitated variations (See Section 4.4.3). For example, a user shared that modifications *"... [were] more just driven by understanding more things about... configuration management [work process] and I suppose understanding ITSM [the System]*." In order to effectively utilize the IS, it is necessary for users to understand the capabilities of the system, as well as how it may be best used within the organizational environment and work processes (Nambisan et al., 1999). Likewise, it is important for users to have sufficient business contextual knowledge in order to make effective of the IS (Kang & Santhanam, 2003).

As users' software understanding increases, the assimilation of its features also increases (Jones et al., 2008). As one user noted, for example, variations occurred as he/she gained more knowledge on the *"different ways that they [other users] do things [in the System]."* As users gain a better understanding the IS, it is anticipated that they will uncover new system features to better support their work tasks (Jones et al., 2008). Furthermore, such knowledge will allow users to understand how to combine and use features of the IS to complete tasks (Coulson, Olfman, Ryan, & Shayo, 2010; Kang & Santhanam, 2003; Sein, Bostrom, & Olfman, 1999).

In most instances, when a Complex IS (e.g. ERP) is deployed as the primary platform for a business process, it often has built-in mechanisms to enforce standard work practices (Kang & Santhanam, 2003). Greater understanding of the work process provides users with knowledge on how all the modules work together in a complex system which makes it easier to identify potential benefits of using the IS in new ways (Sousa & Goodhue, 2003). This was evident in the case studies, for example, as a user recounted, *"...my use has possibly changed [because] I probably better understand why we are doing what we are doing."* Thus, as users increase their business context knowledge, they become more aware of the impact of local changes on other person's jobs, which opens up the possibility for users to identify opportunities to modify work practices to accommodate the IS (Sousa & Goodhue, 2003).

At the same time, insufficient knowledge of the IS features available and applicability in supporting ones' work routines and of an understanding of one's work processes has been shown to be an inhibitor to change (Deng & Chi, 2012). For example a user recounted, "*I don't know what's in there* [the System]. *It's like my cell phone; I don't know what my phone can do. I text and I make calls, but I'm sure if it can do other things*". Furthermore, limited knowledge of the work processes can cause users to question, *"What are we doing this for?"* thus considering engaging with the IS *"a total waste of time."*

In essence, as users gain a better understanding of their work processes in the IS context, it is anticipated that they will uncover new system features to better support these processes (Jones et al., 2008). It is therefore paramount that users understand not only what the system is capable of, but also how work processes can be integrated with one's use of the IS, so as to engage in variations.

Consequently, it is posited that:

H4: Domain-related knowledge is positively associated with Variation

5.3.5 Perceived Resources

Perceived resources can be defined as the extent to which an individual believes that he or she has the personal and organizational resources needed to use an IS (Mathieson, Peacock, & Chin, 2001). Perceived resources impact how much individuals believe that they can execute specific courses of action, and thus can hinder or support use of the IS (Mathieson et al., 2001), and by extension engagement with variations. The case studies suggested that perceived resources, particularly in the form of IS support, triggered or enabled variations, and also that its' absence reduced variations (See Section 4.4.2). As a user remarked *"I know that when I did go and ask a question* [of IS Support], *they would generally give me feedback on how to do something and to better utilize the tools."*

Prior research has shown that perceived resources play an essential role in the success of IS use (Lee, 2008). Especially for Complex Information Systems which are characteristically difficult to understand and use, the existence of different types of IS support is pivotal (Venkatesh & Bala, 2008). It helps to improve users' fluency with the IS over time (Spitler, 2005) and further assist the learning process as users apply the IS in their work (Kang & Santhanam, 2003). Research also suggests that resources can help to develop individual's capacity to use the IS system effectively, (Calvert & Seddon, 2006), which in turn can trigger and/or enable variations.

The availability of resources is positively related to utilization (Marler, Liang, & Dulebohn, 2006), as it helps users to use new features, and to modify or enhance the IS applications and/or related work processes (Jasperson et al., 2005). Hence, it is posited that:

H5: Perceived resources are positively associated with Variations

5.3.6 Feedback valence

Drawing insights from Generalized Darwinism, feedback is recognized as instrumental in the evolution process (Robertson, 1991). Change can occur in all interacting populations of organizations, and such change may be driven by both direct interactions and feedback from rest of system (Volberda & Lewin, 2003). Feedback can also account for relevant alterations in the environment, which may control appropriate internal or behavioral adjustments (Bickhard & Campbell, 2003).

One aspect of feedback that is likely to impact change is feedback valence. The valence of the feedback is the degree to which the feedback is positive or negative (Ilgen & Davis, 2000). Feedback can be considered positive if it is favourable, or if it agrees with or exceeds the receiver's expectations (Smither, London, & Reilly, 2005). On the other hand, feedback can be considered negative if it is unfavourable, or if the receiver interprets the information as less favourable than expected (Smither et al., 2005). Positive feedback is generally considered a deviation-amplifying process, whereas negative feedbacks tends to be considered a deviation-countering process that maintains equilibrium situations (Smith, 1986). It can therefore be argued that the outcome of the feedback provides cues to the individual that may trigger information search and reflection on possible changes in their work system (Ford & Gioia, 2000). Hence this research hypothesizes that positive feedback may cause individuals to change their behaviour, thus performing variations, while negative feedback may indicate undesirable behaviour (Becker & Klimoski, 1989; Van den Bossche, Segers, & Jansen, 2010), and may lead to stasis (Seaborg, 1999). Hence, it is posited that:

H6: The valence of the feedback is positively associated with Variations

5.4 Selection and Retention

Variations provide the raw materials for selective systems to operate on (Mayr, 1991). Selection emphasizes the *differential elimination of certain types of variations*, in which some variants are chosen and others are rejected, while retention represents the case where *selected variants are preserved, duplicated or otherwise reproduced* (Aldrich, 1999). In this study, the process of selection and retention are examined together (rather than as distinct elements) to provide insights into what causes individuals to 'turn a variation into part of their story' about how they perform their work routines (Feldman & Pentland 2003).

Prior literature suggests that when an individual continuously vary their actions over time, it generates more options for selection, and in doing so the chances of finding an effective solution is increased (Breslin & Jones, 2011). Variations increase the variety in the entities of a set, some of which may then be selected and consequently retained (Stoelhorst, 2008d). Thus, if there are many possible variants and there are many selectively superior variants, there is a higher chance of possible retention (Farrell & Shalizi, 2012). Selection and by extension retention, therefore requires variety, for if replenishment of variety is absent, then evolution will cease (Aldrich et al., 2008). Consequently, an increase in variations (i.e. more variety) will increase the likelihood for change through selection and retention. This research therefore posits that:

H7: Variation is positively associated with retention

Furthermore, the findings suggested that *satisfaction* with selected variants had a strong stabilizing effect on maintaining and preserving change (i.e. retention). Satisfaction can be regarded as user's fulfillment response; it is a judgment that a variation provided (or is providing) a pleasurable level of fulfillment relative to one's goal (Oliver, 1997). It is an overall judgment regarding the extent to which feature performance matches expectation (Anderson & Sullivan, 1993). The case findings revealed that users retained a variation, if it met their expectations. For example, a user related such in her decision to continue to use (i.e. to retain) a search features:

> "*… in terms of the search functionality, it was the desire for better output and reporting, and in that sense it's about getting the information that you actually want from the tool and eliminating what you don't. So that kind of concise reporting [was achieved from using it]*." [Advanced User]

After variations are introduced, individuals can either select and retain variations as valuable elaborations to a domain, or reject them as ineffective (Ford & Gioia, 2000). Prior research suggests that satisfaction is an important element of continued use of an IS, while dissatisfaction can trigger discontinuance behaviors (Bhattacherjee, 2001), thus impacting whether or not individuals will continue to use aspects of the IS that they have experimented with. Variations may therefore be retained, providing it serves the individual well, that is, it performed satisfactorily (Furneaux et al., 2010). For instance, if users are dissatisfied, they are less likely to develop positive intentions of continued usage (that is, retention), while satisfied users are more likely to retain a variation, that is, continuing to use the feature (Bhattacherjee & Barfar, 2011). Hence, given that satisfaction is an important determinant of continued use of an IS (Parthasarathy & Bhattacherjee, 1998), it is expected also that satisfaction will also be a key determinant of retention (i.e. continued use) of a selected variant. Thus it is suggested that:

H8: Satisfaction is positively associated with retention

When retention occurs, selected variations are preserved, duplicated, or otherwise reproduced (Aldrich, 1999). Thus, when an individual engages in variations, that is, experimentations with the IS, some of the variants will be selected while others are not selected. When a variation is generated, the user must then not only believe that the variation performs adequately and/or better than the alternatives, they must also be satisfied that the variation is producing the desired outcome (Bickhard & Campbell, 2003; Breslin & Jones, 2011). This increases the likelihood that the variation would be retained in one's routine (Furneaux et al., 2010). Accordingly, while satisfaction with a variation is expected to have a direct impact on retention as evident by continued use of a variant (Bhattacherjee, 2001; Parthasarathy & Bhattacherjee, 1998), it is also suggested that the impact of variation on retention would be greater for higher levels of satisfaction than for lower levels of satisfaction. With the limited research on how different use-types may impact other use-types (Chin & Marcolin, 2001) there are no empirical studies (that we are aware of) that have explored the role of satisfaction in the relationship between use-types. At the same time, it seems reasonable to expect that for users who experience higher levels of satisfaction with variants they have tried, the impact of variations on retention is likely to be greater. Likewise, substantial levels of dissatisfaction with variations are expected to reduce the impact of variations on retention. Hence, it is expected that satisfaction will exert a moderating effect on the relationship between variation and retention. Thus:

H9: The higher the level of satisfaction, the greater the likelihood that variation will lead to greater levels of retention.

5.5 Outcome of Retention (Change)

Retention within routines occurs when an individual turns a variation into part of the story about how they accomplish a work task or process (Feldman & Pentland, 2003), which generates change. While acknowledging that some variations, which are later retained, will be no better than or even inferior to the existing state (Farrell & Shalizi, 2012), this research assumes that as changes occur over time, it is expected that ultimately such changes (in a rational context) would be aimed at developing more deeply ingrained use behaviours. For instance, ultimately retention can result in individuals using more of the IS features in order to accommodate a more comprehensive set of work tasks, that is, *extended use* (Saga & Zmud, 1994). Extended use concerns using a wider array of functionalities for work productivity, thus entailing the use of additional features of the IS (Hsieh & Wang, 2007). *Emergent use* can also arise, as individuals use the IS to accomplish work tasks that were not feasible or recognized prior to the application of the IS within one's work system (Saga & Zmud, 1994) and/or use the IS in an innovative manner (Ng & Kim, 2009; Wang & Hsieh, 2006). Through changes in use, individuals can also further their use of the IS to establish, enhance and/or reinforce

(Ng & Kim, 2009) linkages among tasks (i.e. integrative use) (Ng & Kim, 2009; Saga & Zmud, 1994). In essence, as changes in post-adoptive behaviours occur, users may come to apply unused features, apply already-used features at higher levels of use, discover new uses of existing features, identify the need to incorporate new features into the IS (Jasperson et al, 2005). Consequently, this research posits that:

H10a: Retention is positively associated with extended use

H10b: Retention is positively associated with emergent use

H10c: Retention is positively associated with integrative use

Infusion refers to the process of embedding an IT application deeply and more comprehensively within an individual or organization's work systems (Saga & Zmud, 1994). It represents the highest level of use, and derives from (or is associated with) three (3) 'pathways' of use: *extended use, integrative use and emergent use* (Saga & Zmud, 1994). Extended Use includes using more system features to support one's tasks, which is valuable in achieving the fullest potential of a Complex Information System (Hsieh & Wang, 2007). Greater levels of infusion are also achieved as individuals use the IS in new and innovative ways to accomplish their tasks by way of emergent use (Li et al., 2013; Wang & Hsieh, 2006). Individuals can also more fully use the IS to enrich and broaden their task performance via integrative use, as it allows users to better organize related tasks, enhance coordination of related-tasks and reinforce linkages among tasks and enhance coordination of related-tasks (Ng & Kim, 2009). Hence it is posited that:

H11a: Extended Use is positively associated with infusion

H11b: Emergent Use is positively associated with infusion

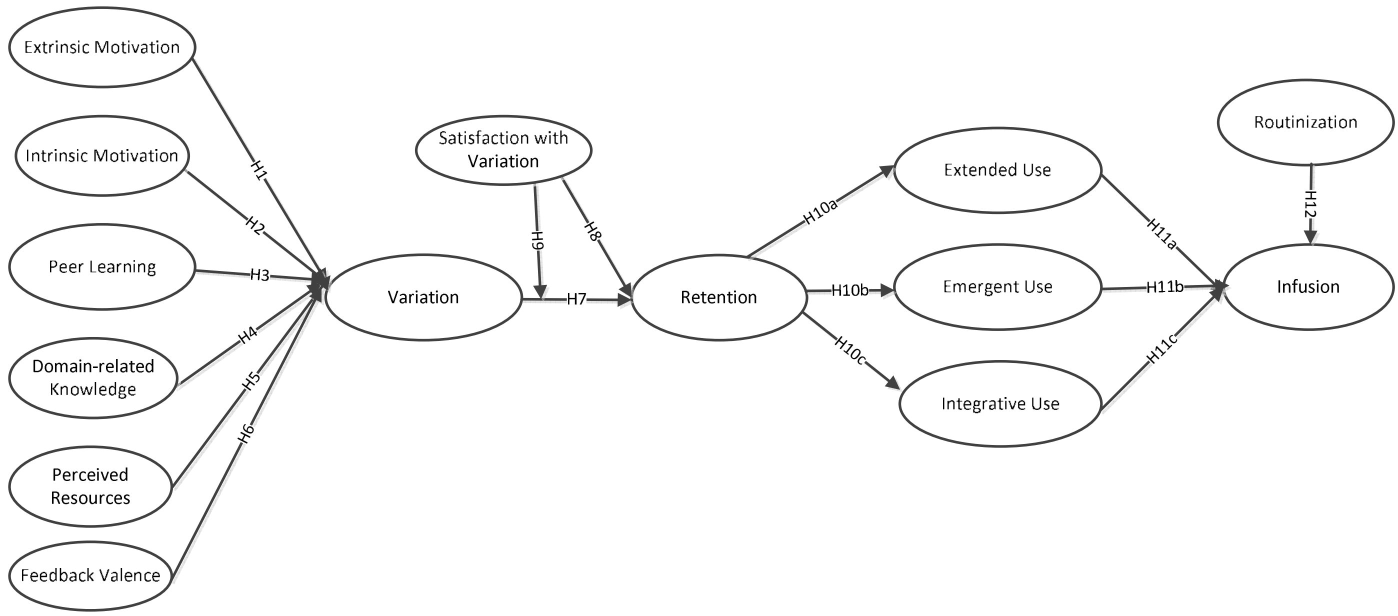
H11c: Integrative Use is positively associated with infusion

As above, prior research posits a relationship between different types of post-adoption use, such that engagement in one form of use may impact other forms of use (Chin & Marcolin, 2001; Sundaram et al., 2007). Routinization (i.e. the integration of the IS into one's normal work routine) likewise is another form of use that may impact infusion (Sundaram et al., 2007). Through routinization, users integrate the technology into daily routines (Schwarz & Chin, 2007). Achieving higher infusion levels may require behavioural changes to enable a stable working-level set of routines, and thus prior research has showed that routinization positively impacts infusion (Sundaram et al., 2007). Behaviours such as routinization can therefore lead to deeper uses of an IS, which in turn supports and enhances how individuals perform in their jobs or tasks (Chin, Mills, Steel, & Schwartz, 2012). Consequently, this study posits that:

H12: Routinization is positively associated with infusion

Bringing together all of the above hypotheses, the research model is shown below in Figure 5.1

Figure 5.1 Overall Research Model



5.6 Sub-Dimension Models

This section details the hypotheses related to the sub-dimensions of particular constructs in the main model, in particular, intrinsic motivation, extrinsic motivation, domain-related knowledge, perceived resources, variation and retention. Although these models views are not core to the main model of change in IS use presented in this study (Benbasat & Zmud, 2003), that is, they are external to the main Generalized Darwinism framework, they provide additional insights into some of the key constructs that are investigated.

5.6.1 Intrinsic Motivation

Compared to extrinsic motivation, researchers have paid significantly less attention to the role of intrinsic motivation in understanding IS use (Li et al., 2013). One possible reason for this is the oversimplified conceptualization of intrinsic motivation towards IS use (Li et al., 2013). Most measures of intrinsic motivation focus on the pleasant sensational experiences of use (Gerow, Ayyagari, Thatcher, & Roth, 2013; Wu & Lu, 2013), with a hedonic emphasis (Li et al., 2013). However a hedonic emphasis is limited as, it does not capture the 'richness' of innate rewarding aspects (Li et al., 2013) and thus neglects other intrinsic motivation such as the cognitive and affective elements (Amabile et al., 1994). Furthermore, intrinsic motivation at work may differ from that in leisure activities and/or hedonic context (Thomas & Velthouse, 1990). Vallerand and his colleagues have proposed a tripartite taxonomy of intrinsic motivation: (i) *intrinsic motivation to know*, (ii) *intrinsic motivation towards accomplishment*, and (iii) *intrinsic motivation to experience stimulation* (Vallerand, 1997; Vallerand & Bissonnette, 1992; Vallerand, Blais, Brière, & Pelletier, 1989; Vallerand et al., 1992). This taxonomy has been successful used to explain motivation in varied domains including academic motivation (Guay, Vallerand, & Blanchard, 2000; Vallerand et al., 1992), sports motivation (Pelletier et al., 1995; Vallerand, 2004), exercise motivation (Li, 1999), and IS use (Li et al., 2013).

Intrinsic motivation to know (IM-to-know) is the engagement in an activity to experience pleasure and satisfaction from learning, exploring or trying to understand something new (Vallerand, 1997). This type of intrinsic motivation relates to constructs such as exploration, intrinsic intellectuality, intrinsic curiosity and intrinsic motivation to learn (Vallerand et al., 1992). Intrinsic motivation was evidenced in the case findings as users proactively engaged with the IS because of the pleasure and satisfaction they experience when learning, exploring, learning or trying to understanding new in the IS. For example, one participant shared, *"I think that I'm probably one of the rare people, where I will make time to read things. I will make time to learn new systems."* In another example, a participant remarked "*I just like to know what it [the System] can do... it's nice to know that there is* *that option [features] available…I do know quite a bit about it [the System].”* Prior research suggests that IM-to-know plays a critical role in post-adoption use, and as an enabler of pro-active use behaviours (Li et al., 2013). Similarly, Yi and Hwang (2003) argue that individuals with high learning goal orientations tend to show more adaptive response patterns where they persist, increase efforts to learn, and enjoy the challenge as they use the IS. Consequently, it is posited that:

H1a: Intrinsic Motivation to know (IM-to-know) is positively associated with Intrinsic Motivation to experiment with Variations

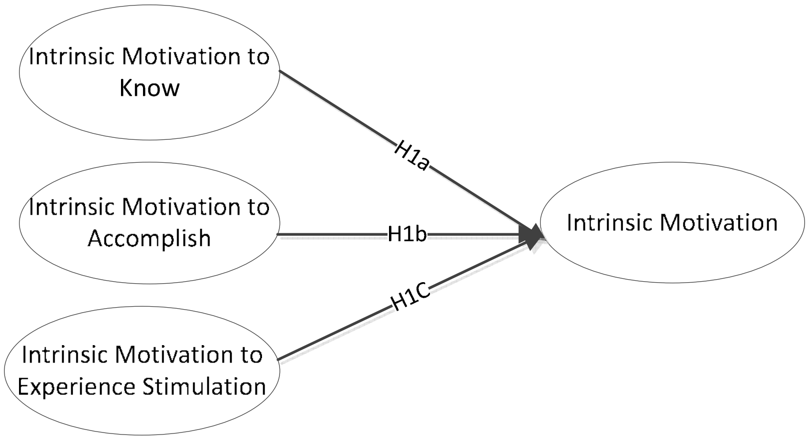
Intrinsic motivation toward accomplishment (IM-to-accomplish) refers to engagement in an activity for the pleasure and satisfaction experienced when attempting task mastery, surpassing oneself, or in trying to accomplish or create something (Pelletier et al., 1995; Vallerand, 1997). This was evident in the case findings, as participants related the pleasure and/or satisfaction they derive from trying to solve problems or accomplishing in the IS. For example, a user recounted *“I just fiddled with it [the CRM] until I got it to what I want it to do. At work I’m really conscientious and really a go-getter and pushy, cause I want it to work.*” Intrinsically motivated individuals tend to also seek out complex and difficult tasks (Amabile et al., 1994), and when they find optimal challenges, they work to conquer them in a persistent way (Deci & Ryan, 1985). Consequently, it is posited that:

H1b: Intrinsic Motivation toward accomplishment is positively associated with Intrinsic Motivation to experiment with Variations

Intrinsic motivation to experience stimulation refers to engagement in activity for feelings of sensory pleasure, fun, excitement or aesthetic enjoyment associated with it (Vallerand, 1997). Research on feelings of fun and excitement in intrinsic motivation has shown positive effects on post-adoption use behaviors such as exploratory usage (Ke et al., 2013) and innovative use (Li et al., 2013). For instance, a participant shared that he/she engaged in variation because “*it’s quite fun to do... just to see what things you can do [in the System].”* Prior research has shown that this positive affect influences creativity (Amabile, Barsade, Mueller, & Staw, 2005) and by extension individuals’ creative performance, thus increasing personal initiative and pro-active behavior (Rank & Frese, 2008). Consequently, it is posited that:

H1c: Intrinsic Motivation to experience stimulation is positively associated with Intrinsic Motivation

Figure 5.2 Model: Forms of Intrinsic Motivation to Intrinsic Motivation

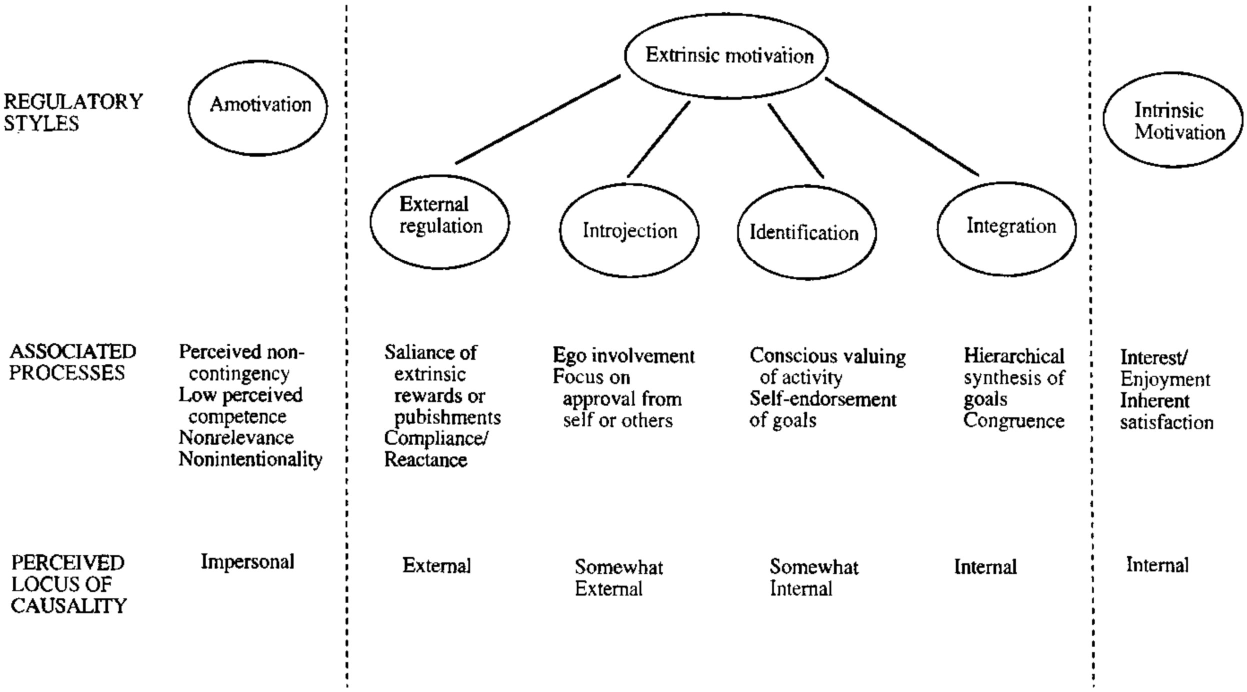


5.6.2 Extrinsic Motivation

Extrinsic motivation pertains to a wide array of behaviors where the goals of the action extend beyond those inherent in the activity itself (Guay et al., 2000). Deci and Ryan (1985) proposed a continuum of behavioral regulation that ranges from non-self-determined regulation (external regulation) to completely self-determined regulation (integrated regulation). Four types of extrinsic motivation have been described by Deci and Ryan (1985), namely *external regulation, introjected regulation, identified regulation, and integrated regulation*. These forms of extrinsic motivation vary by the degree to which individuals internalize and integrate the regulations (Ryan & Deci, 2000a). Internalization is the process of taking in a regulation or value, and integration is the process by which an individual more fully transforms a regulation into their own, so it originates from their sense of self (Ryan & Deci, 2000a). Figure 5.3 shows the full taxonomy of motivations including extrinsic and intrinsic motivation. Based on the case findings, this study further examined three (3) of the types of extrinsic motivation put forward by Deci and Ryan (1985) and evident in the case studies: *external regulation, introjected regulation, and identified regulation*[4]. These are discussed in subsequent paragraphs.

[4] Integrated regulation was not examined in this research. Integration occurs when identified regulations have been fully assimilated to the self, and through self-examination, the individual brings the new regulations into congruence with their other values and needs. The case findings suggested that 'identified regulation' accurately captured the notion of internalizing regulation. Furthermore, it was felt that integrated regulation was not distinctive in the survey context. Consequently integrated regulation was considered a good candidate for exclusion to help reduce the survey length.

Figure 5.3 Taxonomy of Motivation



Source (Ryan & Deci, 2000a)

External regulation is the least autonomous form of extrinsic motivation, and the behavior is performed to satisfy an external demand or to obtain an externally imposed reward contingency (Ryan & Deci, 2000a). External regulation suggests that the individual perceives the origin of one's behavior in external influences or pressures (Malhotra, Galletta, & Kirsch, 2008). The findings from the case studies showed that extrinsic motivation were largely evident in the form of mandated use or directives from management (e.g. to use specific features of the IS), that is, external regulations. For example, in an interview, a user recounted,

> *"One of my Key Performance Indexes in my role is to get a certain number of Keep-in-Touch calls, or sales calls to clients. So there's now a tab [in the CRM] that you can look at and see/check on your sort of monthly progress or how many calls you've made in the last seven days; and it's even to make sure that you're keeping up with what is required of you. So it's sort of self-monitoring [that is useful]... When we were informed that it was going to form part of our performance review and affect our incentive payments if we didn't meet those requirements."*

Arguably, behaviors that are externally regulated are often performed as a result of an external contingency and such contingencies are considered the loci of initiation and regulation (Deci, Vallerand, Pelletier, & Ryan, 1991). With external regulation, the behavior is regulated by rewards or in order to avoid negative consequences, thus regardless of whether the goal of behavior is to obtain rewards or to avoid sanctions, the individual experiences an obligation to behave in a specific way (Guay et al., 2000). Consequently, it is suggested that:

H2a: External Regulation is positively associated with Extrinsic Motivation to experiment with Variations

Another form of extrinsic motivation is *introjected regulation*. Introjection suggests a formerly external regulation has been 'taken in' and is now enforced through internal pressures such as guilt, anxiety, or related self-esteem dynamics (Ryan & Connell, 1989). Through introjection, reliance on environmental regulation is minimized and replaced by new and quite different affective determinants and qualities (Ryan & Connell, 1989). Nevertheless, introjected regulation still retains a quality of pressure and conflict, or a lack of complete integration with the self, and has an external perceived locus of causality nevertheless (Ryan & Deci, 2000b). An example of introjected behavior from the case findings is evidenced below,

> *"I'm a bit from the old school where the sales if they're up there and above budget and everything, well how you get it - who gives a hoot?".... I'm more of a diary, a paper person; and that was it, but I realize now that everything has to be put in the CRM system as such, because they [management] run reports and everything. Even if your sales are really good [if] they can't see what you've been doing to get it [in the CRM]...that's not the way they work these days..."*

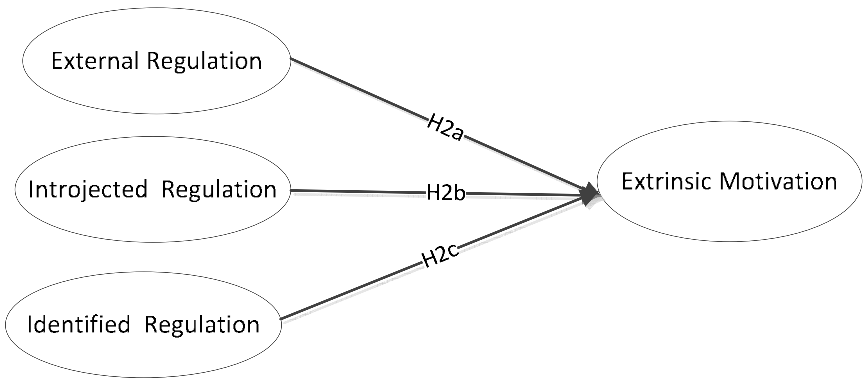
In essence, introjected regulation is more of a controlling than an autonomous type of motivation (Ntoumanis, 2001). As such, with introjected regulation, the value placed on the activity is still governed by external pressure, as the individual has not accepted the action as one's own (Standage, Duda, & Ntoumanis, 2003). Consequently, it is suggested that:

H2b: Introjected Regulation is positively associated with Extrinsic Motivation to experiment with Variations

A more autonomous or self-determined form of extrinsic motivation is *identification regulation.* It reflects a conscious valuing of a behavioral goal or regulation (Ryan & Deci, 2000a; Ryan & Deci, 2000b). With identified regulation, self-determined behaviors occur when individuals place value on and judge an activity as important to the self (Standage et al., 2003). Thus, the action is undertaken because of its value, importance or usefulness (Deci & Ryan, 1985). For example, an interviewee recounted, *"Probably about five/six years ago we were told that we were not to use written diaries, it was all to be done through the computer…So I used the calendar as a call cycle itself…It's the most convenient calendar to use because you were able to sync it through… as our phone technology has got better we're able to actually synchronise through the CRM calendar into our phones and PDA's. So you have that calendar there with you."* Unlike external regulation, identified regulation occurs when a behavior is valued and perceived as being chosen by oneself (Guay et al., 2000). Nonetheless, the motivation is still extrinsic because the activity is not performed for itself but as a means to an end. Hence, it is suggested that:

H2c: Identified Regulation is positively associated with Extrinsic Motivation to experiment with Variations

Figure 5.4. Model: Forms of Regulations to Extrinsic Motivation



5.6.3 Domain-related Knowledge

Knowledge can be defined as a "users' internal understanding of the system that guides interaction and helps solve problems" (Olfman & Sein, 1997, p. 3). There are two aspects of knowledge investigated in this study: (i) Knowledge of IS features and (ii) Work Process Understanding, which are both argued to contribute to knowledge of the IS, hereafter referred to as domain-related knowledge.

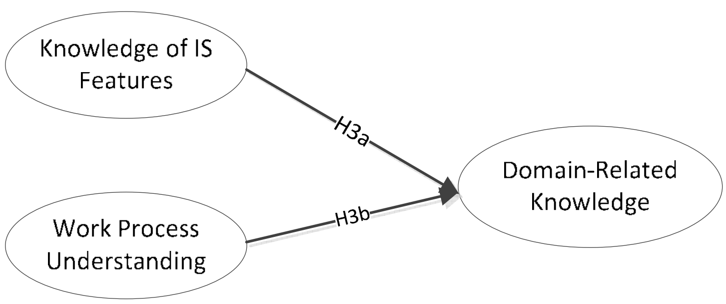
Knowledge of IS features represents a conceptual understanding of the system components, that is, features of the system (Santhanam, Seligman and Kang, 2007). This knowledge relates to the application of the tool's procedures to work tasks, and includes the syntax and semantics of the tool commands, and how to combine and use them to complete tasks (Kang & Santhanam, 2003; Sein et al., 1999). Such knowledge also provides the user with a 'big picture', which covers the overall purpose and the structure of the IS (Sein et al., 1999) which is also paramount in order to effectively use the IS (Nambisan et al., 1999). With a greater understanding of the IS, users are better able to navigate the system features, and thus explore and experiment with the IS (Jones et al., 2008). For example, a user shared "*I think I'm understanding the capabilities better which means that I'm doing more with it as a result.*" Likewise, lack of knowledge of IS features can stagnate post-adoption IS features use (Deng & Chi, 2012; Jones et al., 2008), for instance, a user related "*I've probably used about 2% of what the tool could be used for use it more. Probably better understanding of the tool [would help]*." It is thus suggested that:

H3a: Knowledge of the IS Features is positively associated with Domain-related Knowledge

Work process understanding refers to the extent to which users understand how to perform their own work activities in the IS environment and how their work activities fit into other work processes (Jones et al., 2008). Knowledge of this nature offers an understanding of the workflow of the whole process and the organizational impacts and how the IS application can be used to perform business tasks, and their interdependencies across the organizational functions (Coulson et al., 2010; Kang & Santhanam, 2003; Sein et al., 1999). As a user shared, revisions in use occurred with better understanding of the work processes, "*I really got my head around exactly what went where and how the whole thing fitted in…. Just becoming better at [it]… understanding the relationship between the request and tasks and notes and all that stuff and also just how to use the application…*" Prior research suggests that as users better understand their work processes in the IS context, they will surface new IS features to better support these processes (Jones et al., 2008). It is thus suggested that:

H3b: Work Process Understanding is positively associated with Domain-related Knowledge

Figure 5.5. Model: Types of Knowledge to Domain-Related Knowledge



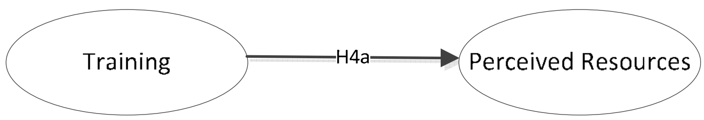
5.6.4 Training

Among the many resources that may facilitate variations, training was mentioned in all of the cases in the qualitative phase. Continuous training, that is, training after the initial period, played an important role in allowing individuals to adapt and learn the IS over time (Spitler, 2005). By training users and providing assistance when they encounter difficulties, this reduces or eliminates under-utilization of the IS (Thompson & Higglns, 1991). As a user related, *"If you can't get something to work or you can't really understand why it doesn't do …they [the trainers] will just clarify."*

Training provides the hands-on mechanism that allows users to explore an IS both from a technical and a functional standpoint (Amoako-Gyampah & Salam, 2004). For example, a user recounted, *"when I did my training she [the trainer] either said, or she started doing it a different way, and I said, "Can you show me that again?" And she hyperlinked the box...and so you do it a different way*." Evidence shows that on-going training is important for developing individuals' capacity to use the IS (Calvert & Seddon, 2006; Nelson & Cheney, 1987) and for overcoming knowledge barriers in use of the IS (Sharma & Yetton, 2007). Training allows users to explore the IS, and as a result they become better aware of the benefits of using the system (Lee, Kim, Rhee, & Trimi, 2006). By contrast, users who receive limited on-going training are less likely to use the IS to better support work processes and to adjust their work processes to accommodate the IS (Jones et al., 2008). Therefore, training is important in the post-adoption context, as users can benefit from previous learning and adjust to ongoing changes in the work system. Thus, it is posited that:

H4A: Training is positively associated with perceived resources

Figure 5.6 Model: Training to Perceived Resources



5.6.5 Variation and Retention

As discussed earlier in this chapter (Section 5.2), this study defines '*Variations*' as '*experiments with* (i) *different ways of using the System to support one's work and/or* (ii) *different ways to do one's work to accommodate the System'*. The literature suggests that for success in use, post-adoptive behaviours should include modifications in both the use of the IS features and in work processes to accommodate the IS (Jasperson et al., 2005; Ke et al., 2013; Orlikowski, 2000; Sun, 2012; Tyre & Orlikowski, 1994).

With that said, this research posits that *Variations* may be represented by two sub-dimensions: variations in feature use (e.g. use of new features, feature substitution, modifying currently-used features) and variations in work processes (e.g. restructuring work process, creating new work processes) (Orlikowski, 2000; Sun, 2012). Likewise, it is suggested that retention consists of two sub-dimensions: retention of variations in feature use (e.g. retaining use of new features) and variations in work processes (e.g. retaining new work processes). Thus, it is posited that:

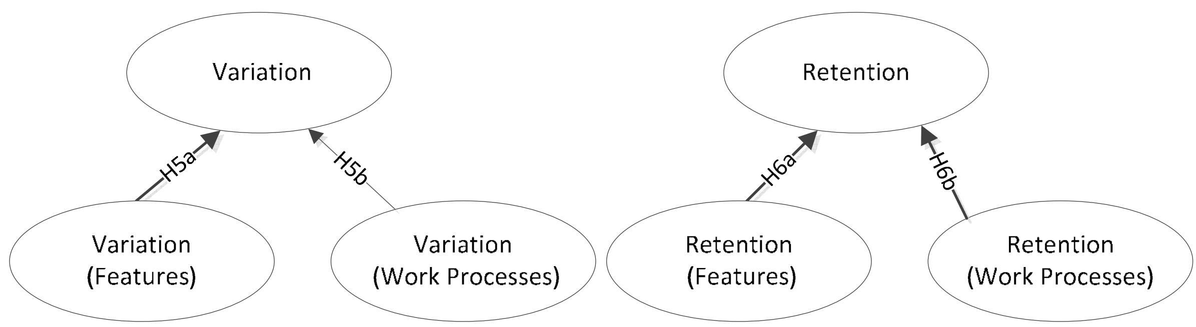
H5a: Variations in Feature Use are positively associated with Variations

H5b: Variations in Work Processes (to accommodate the IS) are positively associated with Variations

H6a: Retention of Variations in Feature Use is positively associated with Retention

H6b: Retention of Variations in Work Processes (to accommodate the IS) is positively associated with Retention

Figure 5.7 Model: Forms of Variation and Retention



5.7 Chapter Reflection

Variations provide the raw materials for selective systems to operate on and retention processes preserve the selected variation (Aldrich, 1999; Hodgson & Knudsen, 2006). Using the concepts of variation, selection and retention as a meta-theory, this chapter used insights from the case studies along with extant literature to refine the research model (Figure 5.1) and support the related research hypotheses. These hypotheses will then be tested and results reported in the next chapter (Chapter 6).

Chapter 6. Survey: Results and Analysis

"The value of having numbers - data - is that they aren't subject to someone else's interpretation. They are just the numbers. You can decide what they mean for you." [Emily Oster]

6.1 Chapter Overview

This chapter details the methodological approach used for the quantitative phase and also reports on the tests of the model and its hypotheses outlined in Chapter 5. The first section outlines the methodology and instrument design process, specifically the pre-test, field study, measurement items, survey design, questionnaire format and administration. The second section focuses on the analysis of the findings from the survey. It will report on the results of both the measurement and structural model tests using PLS Graph.

6.2 Instrument Design

This section details the approach used for instrument design, and is divided into five (5) parts, (i) pre-test, (ii) field survey, (iii) measurement items, (iv) questionnaire format and administration, and (v) data preparation.

6.2.1 Pre-test

Pre-tests present an opportunity for researchers to receive feedback on the survey prior to distribution (Bowden, Fox-Rushby, Nyandieka, & Wanjau, 2002). A pre-test was carried out with academics, research colleagues and target respondents (end users) to judge the appropriateness of the survey questions, that is, whether questions were simple and clear, grammatically correct, and free from jargon (Bowden et al., 2002). Other aspects assessed included the length, format and flow of the survey and completion time.

This was an iterative process, as with each cycle of adjustment, continuous feedback was sought. There were two main phases or rounds of pre-test. During the first round, feedback was received from 8 academics, 4 PhD students, and 4 IS users, which was collated and summarized. Based on the feedback, revisions were made, and the second round focused on feedback gathered from 20 users of the target - Learning Management System. Based on feedback from the respondents, it was clear that there were some aspects of the survey that needed further clarification and adjustment. For example, items used to capture variation and retention was difficult to understand. The survey was also considered too long and repetitious (arising from the use of multiple items and alternative measures (scales) used to capture the various constructs) which affected individuals' willingness to respond.

Drawing on respondent feedback, items were further refined and simplified, the layout of the survey was modified, and some item measures removed from the survey. For the revised survey and before deployment into the field, feedback was sought from 5 LMS users, 2 of who had responded to the original questionnaire. With positive feedback received, the field study was undertaken.

6.2.2. Field Survey

Data for the field study was collected by surveying faculty members who use Learning Management Systems (LMS) to support their work. LMS have many features including file upload and download, discussion forums, assignment submission, instant messaging, online news and announcements, calendaring, quizzes, wikis and reporting facilities for monitoring and managing resource use and student interaction. It can be used as an informational site or as a complete online learning environment. It is a system that is somewhat malleable as faculty can often choose the extent to which they use the system and various features to support their work. In some cases, IT support are able to develop and deploy user-defined features, allowing users through IT to 'create' new features or adjust existing system features for use in their work. The LMS as a study context also provided access to a range of user types and usage levels, making it a useful setting to initiate this study of change in use over time.

Both online and paper-based versions of the survey were administered in this study. The web-based survey was created using Qualtrics. Having an online version, reduced the costly activities of survey reproduction and postage, data entry costs and the effort and duration of survey distribution (Dillman, 2007). Coupled with e-mail, the total communication cost with the survey population was minimized (Dillman, 2007).

An invitation to participate in the study was sent via e-mail to approximately 200 academics in New Zealand; they had the option to complete the online survey or the paper-based version of survey. Persons attending a local Teaching and Learning conference were also invited to participate; they received a paper-based version of the survey. Survey administration spanned a period of 8 weeks, with persons being asked to respond within 2 weeks of receiving the initial invitation to participate. Where possible, follow-up reminders were then sent after the initial invitation period. Most persons (90%) responded within the initial invitation period.

Due to the difficulties encountered in securing responses for the survey, an independent pilot study was not conducted. However given the concerns raised during early rounds of pretesting, after 40 responses were received, the measurement model was evaluated. The results suggested adequate reliability and validity of the construct measures. No further concerns regarding the survey were identified nor were any changes made to the survey instrument. The main data collection therefore proceeded as planned. Altogether 86 responses were received, all of which were usable, yielding a response rate of 34%.

Poor response rates can adversely affect the reliability and generalizability of the findings. Appropriate follow-up reminders and promises of anonymity were some of the approaches used to improve survey response rates (Dillman, 2007). The initial communication to survey participants included clear instructions, and a statement that participation is voluntary, and that no identifying information is gathered in the execution of the survey (Dillman, 2007). Also, to increase the response rate, participants were informed that findings would be available to respondents on request (Dillman, 2007).

6.2.3 Measurement items

Early scholars such as Churchill (1979) emphasized that researchers must be exact in delineating what is included in the definition and what is excluded. Thus, for this research, the first step was to conceptualize and delimit the domain of the constructs. The conceptualization of measurement items involved activities such as defining the construct of interest and generating a candidate list of items from the domain of possible items representing the construct (using insights from the extant literature).

For this study, both newly created and existing items were used. Where feasible, the measures were adapted from previously validated constructs in IS and other domains (e.g. infusion, routinization, etc.), and the wording of the items (where necessary) were modified to fit the context of the IS use. For those constructs with no known existing items (such as variation and retention), measurement items were guided and developed based on the literature in IS and other domains. There were also instances where existing measures did not fit the context of this research, or where the researcher wanted to introduce additional items (e.g. infusion), and hence items were also self-developed in such instances.

For the main research model, scale items were implemented in the survey as follows: variation (3 items), retention (4 items), (overall) extrinsic motivation (2 items), (overall) intrinsic motivation (2 items), peer learning (4 items), perceived resources (5 items), (overall) domain-related knowledge (2 items), feedback valence (3 items), satisfaction with variation (4 items), extended use (4 items), emergent use (5 items), integrative use (6 items), infusion (7 items), and routinization (5 items). The definition, measures and sources for each of these constructs are provided in Table 6.1.

For the sub-dimension models, scale items were implemented in the survey as follows: variations in feature use (5 items), variations in work processes (3 items), retention in variations in feature use (5 items), retention of variations in work processes (3 items), intrinsic motivation to know (2 items), intrinsic motivation towards accomplishment (2 items), intrinsic motivation to experience stimulation (3 items), external regulation (3 items), introjected regulation (2 items), identified regulation (3 items), knowledge of IS features (2 items), work process understanding (2 items), and training (2 items). The definition, measures and sources for each of these constructs are provided in Table 6.2.

Appendix I provide further details, as in addition to the definition, measures and sources used in this research. Appendix I also provides other definitions and measures in the literature, some of which were adapted for this research or used to provide insights for creating new items or adapting existing items to the research context.

Table 6.1 Measurement Items – Main Model

Construct	**Definition**	**Measures (Items)**
Variation	Experiments with (i) different ways of using the System features to support one's work' and/or (ii) different ways to do one's work to accommodate the System (Self-Developed)	**[Var1]** Overall, thinking back to when I first started, I have tried out many different ways to use or accommodate the LMS in in my job (*Strongly Disagree to Strongly Agree)* Overall, thinking back to when you first started, how much have you experimented with different ways of using or accommodating the LMS in your job*?* • **[Var2]** None at all to A Great Amount • **[Var3]** Not at all to A Very Great Extent **(Self-developed items,** *7-point Likert scale)*
Retention	Preserving a change (i.e. a selected variation) in one's work routine (Self Developed)	**[RT1]** Overall, thinking back to when I first started, most of the Variations I have experimented with *(in using or accommodating the LMS in my job)* have been INCLUDED in my work routine (*7-point Likert scale: 'Strongly Disagree to Strongly Agree)* Overall, thinking back to when you first started, of the Variations you have experimented with (*in using or accommodating the LMS in your job)* how much have you INCLUDED in your work routine? • **[RT2]** None at all to A Great Amount • **[RT3]** Not at all to A Very Great Extent (*7-point Likert scale)* **[RT4]** Overall, thinking back to when you first started, of the Variations you have tried out *(in using or accommodating the LMS in your job)* approximately what % have you ADOPTED into your work routine? **(Self-developed items)**

Construct	Definition	Measures (Items)
Intrinsic motivation	Doing of an activity for its inherent satisfactions rather than for some separable consequence (Ryan and Deci, 2000a)	My motivation to experiment with Variations based on **internal needs** (e.g. *needs for fun, discovery, achievement, outdoing others, self-improvement*) is: • **[IntMv1]** Very Weak to Very Strong • **[IntMv2]** Very Low to Very High **(Self-developed items,** *7-point semantic differential scale***)**
Extrinsic motivation	The performance of an activity because it is perceived to be instrumental in achieving valued outcomes that are distinct from the activity itself, such as improved job performance, pay, or promotions (Davis et al., 1992)	My motivation to experiment with Variations based on **external needs** *(e.g. complying with management, work requirements, to avoid punishment or to receive rewards and incentives)* is: • **[ExtMv1]** Very Weak to Very Strong • **[ExtMv2]** Very Low to Very High **(Self-developed items,** *7-point semantic differential scale***)**
Peer Learning	Acquisition of knowledge and skill through active helping and supporting among status equals or matched companions (Topping, 2005)	When it comes to my experimenting with Variations: • **[Peer1]** My co-workers have been instrumental in helping me (Ke et al., 2013) • **[Peer2]** I have received a lot of guidance from my co-workers (Ke et al., 2013) • **[Peer3**] My co-workers have helped me a great deal (Self-Developed) • **[Peer4]** I have learned a lot from my co-workers (Yang, 2007) *(7-point Likert scale, Strongly Disagree to Strongly Agree)*
Perceived Resources	The extent to which an individual believes that he or she has the personal and organizational resources needed to use an IS (Mathieson et al, 2001)	**[RS1]** I have the resources, opportunities, and knowledge I need to experiment with Variations **[RS2]** There are no barriers to my experimenting with Variations **[RS3]** I have access to the resources I need to experiment with Variations **[RS4]** I am able to experiment with Variations if I want to **[RS5]** In general, there are enough resources to support my experimenting with Variations *(Mathieson et al., 2001) (7-point Likert scale, Strongly Disagree to Strongly Agree)*

Construct	Definition	Measures (Items)
Domain-related knowledge	Knowledge represents an understanding of the principles by which a system can be applied and adapted to a business task or process (Santhanam, Seligman, & Kang, 2007)	**[Knw1]** I have a lot of background knowledge when it comes to my experimenting with Variations **[Knw2]** I have the know-how for experimenting with Variations (**Self-developed items,** *7-point Likert scale, Strongly Disagree to Strongly Agree*)
Feedback valence	The valence of the feedback is the degree to which the feedback is positive or negative (Ilgen & Davis, 2000)	On the whole, the feedback you receive when you experiment with a Variation is: • **[FBVL1]** Bad to Good • **[FBVL2]** Negative to Positive • **[FBVL3]** Favourable to Unfavourable (**Self-developed items,** *7-point scale, semantic differential scale*)
Satisfaction with variation	Overall affective evaluation an end-user has regarding his or her experience related with the information system (Chin and Lee, 2000)	All things considered, I am _____ with my Variations • **[SATv1]** Very Dissatisfied to Very Satisfied • **[SATv2]** Very Displeased to Very Pleased • **[SATv3]** Very Frustrated to Very Contented • **[SATv4]** Very Disappointed to Very Delighted (Chin and Lee, 2000, *7-point scale, semantic differential*)
Extended use	Using more of the technology's features in order to accommodate a more comprehensive set of work tasks (Saga and Zmud, 1994)	**[ExtUse1]** Of the **relevant features** of the LMS for supporting your work, about what % are you using? (Percentage) **[ExtUse2]** Of **all the features** that the LMS offers, about what % are you using to support your work? (*Percentage)* **[ExtUse3]** I am using a large percentage (%) of the **relevant** features of the LMS to support my work. (*7-point Likert scale, Strongly Disagree to Strongly Agree)* **[ExtUse4]** I am using a large percentage (%) of **all the features** that the LMS offers to support my work *(7-point Likert scale, Strongly Disagree to Strongly Agree)* **(Self-developed items**)

Construct	Definition	Measures (Items)
Emergent Use	Using the IS in order to accomplish work tasks that were not feasible or recognized prior to the application of the technology to the work system (Saga and Zmud, 1994)	1. About what percentage (%) of the work you are doing with the LMS: • [**EmgUse1]** was **infeasible** to do before the introduction of the LMS? • **[EmgUse2]** is **new** *(i.e., work tasks or processes that did not exist before the introduction of the LMS)*? • **[EmgUse3]** is **innovative** *(i.e. unusual and effective)*? 2. A large percentage (%) of the work I am doing with the LMS: • **[EmgUse4]** was **infeasible** to do before the introduction of the LMS • **[EmgUse5]** is **new** *(i.e., work tasks or processes that did not exist before the introduction of the LMS)* • **[EmgUse6]** is **innovative** *(i.e. unusual and effective)* **(Self-developed items,** *7-point Likert scale, Strongly Disagree to Strongly Agree)*
Integrated Use	Using systems for multi-tasking and in synergistic/holistic manner to enhance workflow (within own workflow and other people) (Self Developed)	1. **[IntUse1]** A large percentage (%) of my use of the LMS enhances the workflow linkages among my tasks 2. **[IntUse2]** I am able to use the LMS to improve the interaction among my work tasks 3. **[IntUse3]** My use of the LMS enables my tasks to fit better with other tasks in my workflow 4. **[IntUse4]** My use of the LMS to support my workflow can be described as integrated 5. **[IntUse5]** My use of the LMS improves the synergy among my work tasks 6. **[IntUse6]** Using the LMS enhances the integration between various tasks within my work processes **(Self-developed items,** *7-point Likert scale, Strongly Disagree to Strongly Agree*)

Construct	Definition	Measures (Items)
Infusion	The extent to which the user fully utilizes the system to enhance his/her productivity (Jones et al., 2002)	1. **[INF1]** I am using the LMS to its fullest potential for supporting my work (Jones et al., 2002) 2. **[INF2]** I am using all the capabilities of the LMS in the best fashion to help me on the job (Jones et al., 2002) 3. **[INF3]** I doubt that there are any better ways for me to use the LMS to support my work (Jones et al., 2002) 4. **[INF4]** My use of the LMS on the job has been integrated and incorporated at the highest level (Jones et al., 2002) 5. **[INF5]** I am using the LMS in the best way possible to support my work (Self-Developed) 6. **[INF6]** My use of the LMS can be described as being at the highest level to support my work (Self-Developed) 7. **[INF7]** I doubt that I can extract any more benefits from using the LMS for my work (Self-Developed) *(7-point Likert scale, Strongly Disagree to Strongly Agree)*
Routinization	The extent to which the use of the technology has been integrated into the individual's normal work routine (Sundaram et al., 2007)	My use of the LMS: • **[RTN1]** has been incorporated into my regular work schedule (Sundaram et al., 2007) • **[RTN2]** is pretty much integrated as part of my normal work routine (Sundaram et al., 2007) • **[RTN3]** is a normal part of my work (Sundaram et al., 2007) • **[RTN4]** is a natural part of the way I work (Sundaram et al., 2007) • [**RTN5]** have been routinized into my work (Self-Developed) *(7-point Likert scale, Strongly Disagree to Strongly Agree*

Table 6.2 Measurement Items – Sub-Dimensions

Construct	Definition	Measures (Items)
Variation	Experiments with (i) different ways of using the System features to support one's work and/or (ii) different ways to do one's work to accommodate the System (Self-Developed).	***Variation (in Features)*** In using the LMS, how much have you experimented with: • **[VarF1]** using new features to support your work? • **[VarF2]** changing how you use current features for your work? • **[VarF3]** substituting (replacing) features you have been using with other LMS features to do your work? • **[VarF4]** using various features in new ways to do your work? • **[VarF5]** using different features in innovative ways (i.e. unusual and effective) for your work? **(Self-developed items,** *7-point Likert scale, Not at all to A Great Amount*) ***Variation (in Work Process)*** To accommodate the LMS in your work, how much have you experimented with: • **[VarWP1]** restructuring the way you do your job? • **[VarWP2]** creating new ways to do your work? • **[VarWP3]** creating innovative ways (i.e. unusual and effective) to do your work? **(Self-developed items,** *7-point Likert scale, Not at all to A Great Amount*)

Construct	Definition	Measures (Items)
Retention	Preserving a change (i.e. a selected variation) in one's work routine (Self Developed	***Retention (of Variation in Features)*** In using the LMS, how much of the following Variations have you INCLUDED in your work routine: • **[RTF1]** new features you have used to support your work? • **[RTF2]** changes in how you use current features to do your work? • **[RTF3]** substitution (replacement) of features you have been using with other LMS features to do your work? • **[RTF4]** new ways of using various features to do your work? • **[RTF5]** innovative ways (i.e. unusual and effective) of using different features to support your work? **(Self-developed items,** *7-point Likert scale, Not at all to A Great Amount*) ***Retention (of Variation in Work Processes)*** To accommodate the LMS in your work, how much of the following Variations have you INCLUDED in your work routine: • **[RTWP1]** restructuring in the way you do your job • **[RTWP2]** new ways you have created to do your work • **[RTWP3]** innovative ways (i.e. unusual and effective) you have created to do your work **(Self-developed items,** *7-point Likert scale, Not at all to A Great Amount*)
Intrinsic motivation to know	Performing an activity for the pleasure and the satisfaction that one experiences while learning, exploring, or trying to understand something new (Vallerand et al., 1995)	When experimenting with Variations: • **[IMKnw1]** I get enjoyment from learning new things (Guay et al., 2003) • **[IMKnw2]** I receive satisfaction from acquiring new knowledge (Guay et al., 2003) *(7-point Likert scale, Strongly Disagree to Strongly Agree)*
Intrinsic motivation towards accomplishment	Engaging in an activity for the pleasure and satisfaction experienced when one attempts to accomplish or create something (Vallerand et al., 1995)	When experimenting with Variations: 1. **[IMAcp1]** I experience satisfaction from outdoing myself (Guay et al., 2003) 2. **[IMAcp2]** I experience satisfaction from surpassing myself (Guay et al., 2003) *(7-point Likert scale, Strongly Disagree to Strongly Agree*

Construct	Definition	Measures (Items)
Intrinsic motivation to experience stimulation	Engaging in an activity in order to experience stimulating sensations (adapted, Vallerand et al., 1995)	When experimenting with Variations: • [**IMSt1]** I get enjoyment from fulfilling my intrinsic need for fun • **[IMSt2]** I get pleasure from advancing my need for fun • **[IMSt3]** I receive satisfaction from supporting my internal need for enjoyment **(Self-developed items,** *7-point Likert scale, Strongly Disagree to Strongly Agree*)
External Regulation	Behaviors are performed to satisfy an external demand or obtain an externally imposed reward contingency (Ryan and Deci, 2000a)	1. **[ExtReg1]** I am supposed to experiment with Variations (Ryan and Connell, 1989) 2. **[ExtReg2]** Experimenting with Variations is something that I have to do (Guay et al., 2000) 3. **[ExtReg3]** I feel that I have to experiment with Variations adapted (Guay et al., 2000) *(7-point Likert scale, Strongly Disagree to Strongly Agree)*
Introjected Regulation	This is a type of internal regulation that is still quite controlling because people perform such actions with the feeling of pressure in order to avoid guilt or anxiety or to attain ego-enhancements or pride (Ryan and Deci, 2000a)	1. **[IJReg1]**People who are important to me think that I should experiment with Variations 2. **[IJReg2]**People whose opinions matter to me think that I should experiment with Variations **(Self-developed items,** *7-point Likert scale, Strongly Disagree to Strongly Agree*)
Identified Regulation	The person has identified with the personal importance of a behavior and has thus accepted its regulation as his or her own. Regulation	1. [**IDReg1]**Experimenting with Variations is important for me (Guay et al., 2000) 2. **[IDReg2]** I believe that experimenting with Variations is good for me (Guay et al., 2000) 3. **[IDReg3]** Experimenting with Variations is of value to me (Self-developed) (*7-point Likert scale, Strongly Disagree to Strongly Agree)*

Construct	Definition	Measures (Items)
Knowledge of IS features	IS Feature Knowledge represents a conceptual understanding of the system components, that is, features of the system (Santhanam, Seligman and Kang, 2007, modified)	When it comes to my experimenting with Variations: • **[KnwF1]** I know the features of the LMS (Nambisan, 1999) • **[KnwF2]** I understand all aspects of the LMS (Self Developed) (*7-point Likert scale, Strongly Disagree to Strongly Agree)*
Work Process Understanding	The extent to which users understand how to perform their own work activities in the IS environment and how their work activities fit into other work processes (Jones et al., 2008, modified)	When it comes to my experimenting with Variations: • **[KnwWP1]** I understand how the task(s) I do fit into the overall work process • **[KnwWP2]** I understand the overall work process that my task(s) is part of *(Jones et al., 2008) (7-point Likert scale, Strongly Disagree to Strongly Agree)*
Training (formal)	Formal training refers to training that is formally planned by an organization to educate employees about the IS and how it can be used (Self Developed)	When it comes to my experimenting with Variations: • **[TRN1]** I receive good training from my organization • **[TRN2]** The kind of training provided by my organization is satisfactory **(Self-developed items,** *7-point Likert scale, Strongly Disagree to Strongly Agree*)

6.2.4 Questionnaire Format and Administration

Appendix J provides the survey instrument used in this research, which consisted of four (4) main sections:

1. The first section, that is, the front page of the questionnaire, included a brief introduction of the purpose of the research. The front page also included assurances of confidentiality and anonymity, and other human ethics statements about participation as required by the University of Canterbury.
2. In section two (2), participants were asked to respond to questions about their experience with the LMS, including their user-type (that is, basic, intermediate or advanced), and their extent of use (e.g. amount of use). Responses were captured using 7-point Likert scales and semantic differential scales.
3. In section three (3), participants were asked to answer questions with regards to their change in use over time (e.g. variation). The items used various scales with some anchored with 7-point Likert scales, while others used 7-point semantic differential scales.
4. In the last section, participants were asked to provide some demographic information for descriptive statistical purposes, such as type and size of organization worked for, and personal demographics such as gender and age.

6.2.5 Data Preparation

The data preparation process entailed coding and data entry into a database (in Microsoft Excel), data-filtering and identifying missing responses (Fink, 2006). The surveys were numbered as received from participants and checked to ensure completeness and readability of the responses. Frequencies were computed for each item and checks made for missing data and to identify outlier responses. Missing data points were coded as '999'. Checks were also made to (i) ensure that the respondents answered questions appropriately, that is, selecting a response within the given range, or (ii) identify and eliminate respondents that provided serial responses.

The data was then analyzed using the statistical package SPSS 20.0 for Mac and PLS-Graph. SPSS was used to calculate frequencies for all variables, to check for absent data, and any coding errors in the data entry process. For missing data, missing value analysis was done in SPSS using Expectation-Maximization (EM) algorithm. The EM algorithm has proved a flexible tool for calculating maximum likelihood estimates in a variety of problems involving missing data or incomplete information (Lauritzen, 1995). The analysis revealed non-significant findings (that is, p-values > 0.10), which is consistent with the assumption that data is completely missing at random (Laird, Lange, & Stram, 1987). Hence, expectation maximization was applicable for addressing the problem of missing values.

Data from the final survey was also statistically examined via SPSS (for descriptives) and PLS-Graph was used to assess the measurement and structural models. All 86 responses were usable and were included in the analysis.

6.3 Data Analysis

This section details the findings from the quantitative phase and follows the reporting structure proposed by Chin (2010). First, descriptive statistics are provided so as provide information needed to understand the sample (respondents). PLS Graph, a component-based path approach was then used to assess the measurement and the structural model. The results of the PLS analysis are then presented in terms of the measurement model, followed by the structural model. For the measurement model, tests include internal consistency reliability, and convergent and discriminant validity of the instrument items. For the structural model, the hypotheses were tested.

6.3.1 Descriptive Statistics of the Participants

The demographic profile of the survey respondents, including their gender, age, position, experience with an LMS, user type and amount of use are outlined and discussed in this section. These demographic figures are summarized in Table 6.3.

Overall, 56 males participated in this survey, which represents 67% of the total respondents; 28 females participated (33%). The 46-55 year group ranked highest with 27 respondents (32%), followed closely by the 36-45 year group with 26 respondents (31%). With regard to the job position of respondents, 6 (8%) were Professors, 6 (8%) were Associate Professors, 14 (18%) were Senior Lecturers, 29 respondents (38%) were Lecturers, 15 (19%) were Tutors, and 7 (9%) were Academics with significant Administrative responsibility (such as Heads of Department).

Respondents were asked to rate their level of expertise with the LMS on a seven-point scale ranging from -3 (basic level) to +3 (advanced level). This research grouped users that responded -3 to -1 as basic users, 0 to +1 as intermediate users and +2 to +3 as advanced users. Of the 86 that provided their use type, 14 (19%) were therefore classified as basic users, 38 (45%) as intermediate users, and 31 (36%) as advanced users.

Turning to the amount of use, 38 (44%) respondents used the LMS a few times a week. Another 21 (25%) used the LMS several times a day, while 13 (15%) used it about once a day. The remaining 14 (16%) used the LMS about once a week or less.

Table 6.3 Demographic Statistics of Respondents

Demographic Variable (n=86)	Frequency	Percentage (%)
Gender (2 missing)		
Male	56	67%
Female	28	33%
Age (years)		
26-35	12	14%
36-45	26	31%
46-55	27	32%
Over 56	19	23%
Position (9 missing)		
Tutor	15	19%
Lecturer	29	38%
Senior Lecturer	14	18%
Associate Professor	6	8%
Professor	6	8%
Administrative Position	7	9%
Experience with LMS (1 missing)		
Less than 6 months	4	5%
6 months to < 1 year	6	7%
1-2 years	10	12%
3-4 years	33	39%
5-6 years	11	13%
7-10 years	13	15%
More than 10 years	8	9%
User Type (3 missing)		
Basic	14	19%
Intermediate	38	45%
Advanced	31	36%
Amount of Use		
About once a month	3	3%
A few times a month	4	5%
About once a week	7	8%
Few times a week	38	44%
About once a day	13	15%
Several times a day	21	25%

6.3.2 Measurement Model Assessment

Measurement model evaluation determines the reliability and validity of constructs based on the theoretical context. In the research model, all constructs were modelled as reflective. In this section, the reliability, convergent validity and the discriminant validity are examined.

6.3.2.1 Reliability

Reliability is a statement about measurement accuracy, in particular, the extent to which an instrument produces consistent or error free results (Boudreau et al., 2001). It speaks to the stability of individual measures across replications from the same source of information (Straub, 1989). The most commonly used measure of reliability is internal consistency reliability, which will be used in this research (Hair et al., 2013).

To assess internal consistency, this study examined composite reliability (Chin, 2010) using PLS-Graph. The findings revealed that composite reliabilities (CR) ranged from 0.888 to 0.998 (See Table 6.4) and were therefore well above the recommended cut-off of 0.70 indicating internal consistency and that all constructs are within accepted limits and reliable (Chin, 2010; Hair et al., 2013)

An examination of the factor loadings showed that, except for one item (INF7), factor loadings ranged from 0.776 to 0.992, exceeding the recommended thresholds of 0.70 (Chin, 2010). INF7 (0.671) was newly developed for this study. Although the factor loading for INF7 exceeded the 0.50 threshold for exploratory work (Chin, 2010) it is suggested this measure be revisited in future work.

Table 6.4 Factor Loadings, CR and AVE

Construct/Item	Factor Loadings	CR	AVE
Variation (Overall) [Var]		**0.972**	**0.921**
Var1	0.932		
Var2	0.976		
Var3	0.971		
Variation in Feature Use [VarF]		**0.954**	**0.806**
VarF1	0.906		
VarF2	0.903		
VarF3	0.825		
VarF4	0.942		
VarF5	0.908		
Variation in Work Process [VarWP]		**0.928**	**0.811**
VarWP1	0.889		
VarWP2	0.946		
VarWP3	0.865		
Retention (Overall) [RT]		**0.948**	**0.820**
RT1	0.905		
RT2	0.962		
RT3	0.959		
RT4	0.785		
Retention of Variation in Feature Use [RTF]		**0.960**	**0.827**
RTF1	0.887		
RTF2	0.938		
RTF3	0.846		
RTF4	0.949		
RTF5	0.922		
Retention of Variation in Work Process [RTWP]		**0.943**	**0.847**
RTWP1	0.869		
RTWP2	0.957		
RTWP3	0.932		
Extrinsic Motivation (Overall) [ExMv]		**0.997**	**0.993**
ExtMv1	0.997		
ExtMv2	0.997		
External Regulation [ExtReg]		**0.950**	**0.864**
ExtReg1	0.937		
ExtReg2	0.929		
ExtReg3	0.922		
Introjected Regulation [IJReg]		**0.996**	**0.992**
IJReg1	0.996		
IJReg2	0.996		
Identified Regulation [IDReg]		**0.930**	**0.816**
IDReg1	0.909		
IDReg2	0.852		
IDReg3	0.946		

Construct/Item	Factor Loadings	CR	AVE
Intrinsic Motivation (Overall) [IntMv]		**0.998**	**0.996**
IntMv1	0.998		
IntMv2	0.998		
Intrinsic Motivation to Know [IMKnw]		**0.926**	**0.862**
IMKnw1	0.932		
IMKnw2	0.925		
Intrinsic Motivation to Accomplish [IMAcp]		**0.985**	**0.971**
IMAcp1	0.985		
IMAcp2	0.985		
Intrinsic Motivation to Experience Stimulation [IMSt]		**0.978**	**0.937**
IMSt1	0.968		
IMSt2	0.976		
IMSt3	0.959		
Peer Learning [Peer]		**0.973**	**0.899**
Peer1	0.947		
Peer2	0.927		
Peer3	0.947		
Peer4	0.971		
Domain-Related Knowledge [Knw]		**0.976**	**0.954**
Knw1	0.979		
Knw2	0.975		
Knowledge of IS Features [KnwF]		**0.946**	**0.898**
KnwF1	0.961		
KnwF2	0.934		
Work Process Understanding [KnwWP]		**0.966**	**0.934**
KnwWP1	0.966		
KnwWP2	0.967		
Perceived Resources [RS]		**0.921**	**0.701**
RS1	0.895		
RS2	0.813		
RS3	0.909		
RS4	0.717		
RS5	0.839		
Training [TRN]		**0.950**	**0.906**
TRN1	0.949		
TRN2	0.954		
Feedback Valence [FBVL]		**0.966**	**0.905**
FBVL1	0.945		
FBVL2	0.949		
FBVL3	0.960		
Satisfaction [SATv]		**0.958**	**0.850**
SATv1	0.926		
SATv2	0.958		
SATv3	0.918		
SATv4	0.884		

Construct/Item	Factor Loadings	CR	AVE
Extended Use [ExtUse]		**0.888**	**0.665**
ExtUse1	0.789		
ExtUse2	0.843		
ExtUse3	0.801		
Integrative Use [IntUse]		**0.977**	**0.877**
IntUse1	0.918		
IntUse2	0.972		
IntUse3	0.959		
IntUse4	0.882		
IntUse5	0.950		
IntUse6	0.937		
Emergent Use [EmgUse]		**0.934**	**0.702**
EmgUse1	0.802		
EmgUse2	0.854		
EmgUse3	0.847		
EmgUse4	0.870		
EmgUse5	0.831		
EmgUse6	0.822		
Infusion [INF]		**0.944**	**0.708**
INF1	0.816		
INF2	0.864		
INF3	0.754		
INF4	0.954		
INF5	0.882		
INF6	0.915		
INF7	0.671		
Routinization [RTN]		**0.969**	**0.862**
RTN1	0.915		
RTN2	0.951		
RTN3	0.963		
RTN4	0.858		
RTN5	0.951		

6.3.2.2 Convergent Validity

Convergent validity indicates the extent to which items converge in their representation of the underlying construct they are purported to measure (Chin, 2010). Convergent validity is considered satisfactory when the AVE for the construct is 0.50 or more. In this research, the AVEs ranged from 0.665 to 0.996 (See Table 6.4), which suggests that the construct explains more than half of the variance of its indicators (Chin, 2010). Also, the factor loadings for each construct had a narrow range (Chin, 2010), as evidenced in Table 6.4, which suggests that the items converge in estimating the underlying construct (Chin, 2010).

6.3.2.3 Discriminant Validity

Discriminant validity was also evaluated to assess the extent to which each construct is distinct from other constructs by empirical standards (Hair et al., 2013). Two approaches were used to assess discriminant validity: (i) comparing the square root of the average variance extracted with the correlations among constructs and (ii) assessing whether each item loads more highly on its own construct than on other constructs (Chin, 2010).

The results showed that the square root of each construct's AVE was greater than its highest correlation with any other construct (See Table 6.5), which suggests that all constructs share more variance with its associated indicators than with any other construct (Hair et al., 2013). The results indicate that each construct is much more closely related to its own indicators than to other constructs, hence satisfying the criteria for discriminant validity (Chin 2010). (See Table 6.6)

Table 6.5 Discriminant Validity (Squared Correlations and AVE)

	CR	AVE	**Var**	**VarF**	**VarWP**	**RT**	**RTF**	**RTWP**	**ExtMot**	**ExReg**	**IJReg**	**IntMov**	**IMKnw**	**IMAcp**	**IMSt**	**Peer**
Var	0.972	0.921	1.000													
VarF	0.954	0.806	0.661	1.000												
VarWP	0.928	0.811	0.512	0.658	1.000											
RT	0.948	0.820	0.486	0.420	0.323	1.000										
RTF	0.960	0.827	0.488	0.659	0.502	0.599	1.000									
RTWP	0.943	0.847	0.418	0.641	0.543	0.556	0.814	1.000								
ExtMot	0.997	0.993	0.007	0.032	0.006	0.013	0.021	0.027	1.000							
ExReg	0.950	0.864	0.030	0.029	0.005	0.038	0.040	0.072	0.177	1.000						
IJReg	0.996	0.992	0.045	0.061	0.045	0.050	0.083	0.087	0.134	0.296	1.000					
IDReg	0.930	0.816	0.210	0.177	0.130	0.146	0.143	0.120	0.092	0.320	0.281					
IntMov	0.998	0.996	0.125	0.108	0.099	0.052	0.085	0.062	0.077	0.139	0.236	1.000				
IMKnw	0.926	0.862	0.122	0.100	0.111	0.106	0.075	0.095	0.031	0.067	0.173	0.263	1.000			
IMAcp	0.985	0.971	0.043	0.040	0.019	0.016	0.014	0.013	0.031	0.108	0.285	0.246	0.393	1.000		
IMSt	0.978	0.937	0.048	0.065	0.027	0.052	0.064	0.064	0.023	0.098	0.241	0.216	0.511	0.514	1.000	
Peer	0.973	0.899	0.005	0.000	0.009	0.017	0.000	0.001	0.038	0.005	0.021	0.052	0.028	0.019	0.000	1.000
Knw	0.976	0.954	0.208	0.125	0.097	0.036	0.038	0.020	0.006	0.009	0.022	0.133	0.132	0.093	0.095	0.008
KnwF	0.946	0.898	0.106	0.074	0.052	0.000	0.003	0.001	0.004	0.010	0.018	0.088	0.114	0.116	0.090	0.008
KnwWP	0.966	0.934	0.092	0.060	0.122	0.018	0.010	0.007	0.013	0.013	0.016	0.015	0.142	0.093	0.065	0.000
RS	0.921	0.701	0.023	0.009	0.021	0.015	0.001	0.002	0.003	0.000	0.001	0.009	0.003	0.003	0.010	0.002
TRN	0.950	0.906	0.000	0.003	0.000	0.016	0.007	0.000	0.027	0.006	0.000	0.026	0.002	0.021	0.026	0.013
FBVL	0.966	0.905	0.219	0.083	0.091	0.131	0.128	0.067	0.025	0.011	0.058	0.079	0.109	0.057	0.133	0.004
Sat	0.958	0.850	0.173	0.118	0.146	0.146	0.073	0.054	0.004	0.026	0.040	0.115	0.163	0.138	0.128	0.006
ExtUse	0.888	0.665	0.339	0.239	0.189	0.207	0.190	0.138	0.028	0.040	0.116	0.104	0.105	0.138	0.095	0.021
EmgUse	0.934	0.702	0.276	0.310	0.221	0.237	0.347	0.328	0.056	0.047	0.137	0.197	0.118	0.106	0.151	0.004
IntUse	0.977	0.877	0.100	0.126	0.122	0.042	0.064	0.085	0.071	0.044	0.109	0.123	0.123	0.142	0.133	0.001
INF	0.944	0.708	0.209	0.139	0.148	0.047	0.080	0.050	0.011	0.020	0.075	0.079	0.063	0.051	0.059	0.005
RTN	0.969	0.862	0.149	0.100	0.143	0.128	0.157	0.188	0.032	0.061	0.089	0.058	0.163	0.028	0.041	0.003

Key: Var=Variation; VarF=Variation in Feature Use; VarWP= Variation in Work Processes; RT= Retention; RTF= Retention of Variations in Feature Use; ExtMv=Extrinsic Motivation; ExReg= External Regulation; IJReg= Introjected Regulation; IDReg= Identification Regulation; IntMv=Intrinsic Motivation; IMKnow= Intrinsic Motivation to Know; IMAcp= Intrinsic Motivation toward Accomplishment; IMSt= Intrinsic Motivation to Experience Stimulation; Peer=Peer Learning; RS=Perceived Resources; Knw=Domain-related Knowledge; KnwF=Knowledge of Feature; KnwWP= Knowledge of Work Processes; RS=Resources; TRN=Training; FBVL= Feedback Valence; Sat=Satisfaction; ExtUse=Extended Use; EmgUse=Emergent Use; IntUse=Integrative Use; INF=Infusion; RTN=Routinization

Table 6.5 Discriminant Validity (Squared Correlations and AVE) (Cont'd)

	CR	AVE	**Knw**	**KnwF**	**KnwWP**	**RS**	**TRN**	**FBVL**	**Sat**	**ExtUse**	**EmgUse**	**IntUse**	**INF**	**RTN**
Knw	0.976	0.954	1.000											
KnwF	0.946	0.898	0.425	1.000										
KnwWP	0.966	0.934	0.385	0.398	1.000									
RS	0.921	0.701	0.151	0.069	0.201	1.000								
TRN	0.950	0.906	0.013	0.034	0.047	0.385	1.000							
FBVL	0.966	0.905	0.171	0.022	0.126	0.104	0.023	1.000						
Sat	0.958	0.850	0.091	0.043	0.077	0.062	0.016	0.212	1.000					
ExtUse	0.888	0.665	0.285	0.194	0.207	0.082	0.072	0.252	0.224	1.000				
EmgUse	0.934	0.702	0.065	0.027	0.012	0.000	0.003	0.245	0.150	0.272	1.000			
IntUse	0.977	0.877	0.130	0.139	0.146	0.044	0.032	0.176	0.129	0.359	0.278	1.000		
INF	0.944	0.708	0.452	0.271	0.187	0.093	0.036	0.157	0.067	0.411	0.134	0.259	1.000	
RTN	0.969	0.862	0.020	0.024	0.082	0.008	0.003	0.094	0.058	0.180	0.115	0.287	0.080	1.000

Key: Var=Variation; VarF=Variation in Feature Use; VarWP= Variation in Work Processes; RT= Retention; RTF= Retention of Variations in Feature Use; ExtMv=Extrinsic Motivation; ExReg= External Regulation; IJReg= Introjected Regulation; IDReg= Identification Regulation; IntMv=Intrinsic Motivation; IMKnow= Intrinsic Motivation to Know; IMAcp= Intrinsic Motivation toward Accomplishment; IMSt= Intrinsic Motivation to Experience Stimulation; Peer=Peer Learning; RS=Perceived Resources; Knw=Domain-related Knowledge; KnwF=Knowledge of Feature; KnwWP= Knowledge of Work Processes; RS=Resources; TRN=Training; FBVL= Feedback Valence; Sat=Satisfaction; ExtUse=Extended Use; EmgUse=Emergent Use; IntUse=Integrative Use; INF=Infusion; RTN=Routinization

Table 6.6 Item Loadings and Cross Loadings for Constructs

indicator	Factor Loading	Var	VarF	VarWP	GRT	RTF	RTWP	ExtMV	ExREGv	IJREGv	IDREGv	IntMV	IMKnw	IMAcp	IMSt	Peer	Knw	KnwF	KnwWP
Var1	**0.932**	**0.932**	0.775	0.686	0.706	0.699	0.657	0.097	0.186	0.268	0.478	0.367	0.411	0.257	0.293	0.113	0.435	0.301	0.321
Var2	**0.976**	**0.976**	0.777	0.681	0.636	0.641	0.583	0.070	0.139	0.154	0.425	0.319	0.300	0.171	0.158	0.050	0.443	0.337	0.277
Var3	**0.971**	**0.971**	0.786	0.691	0.660	0.667	0.617	0.076	0.171	0.180	0.413	0.329	0.288	0.167	0.174	0.046	0.433	0.299	0.270
VarF1	**0.906**	0.772	**0.906**	0.746	0.591	0.732	0.721	0.157	0.247	0.260	0.442	0.379	0.385	0.231	0.259	0.084	0.423	0.334	0.264
VarF2	**0.903**	0.765	**0.903**	0.774	0.638	0.759	0.716	0.162	0.147	0.190	0.393	0.260	0.246	0.093	0.115	-0.021	0.236	0.169	0.151
VarF3	**0.825**	0.640	**0.825**	0.654	0.549	0.679	0.699	0.127	0.021	0.079	0.380	0.130	0.235	0.134	0.165	-0.074	0.274	0.177	0.227
VarF4	**0.942**	0.756	**0.942**	0.727	0.588	0.730	0.707	0.175	0.122	0.250	0.348	0.329	0.295	0.242	0.262	-0.012	0.330	0.254	0.241
VarF5	**0.908**	0.708	**0.908**	0.737	0.547	0.743	0.752	0.176	0.198	0.301	0.327	0.347	0.244	0.187	0.325	-0.081	0.309	0.266	0.212
VarWP1	**0.889**	0.591	0.652	**0.889**	0.465	0.567	0.612	-0.006	-0.022	0.022	0.295	0.186	0.261	0.080	0.072	-0.130	0.278	0.203	0.329
VarWP2	**0.946**	0.705	0.730	**0.946**	0.568	0.656	0.667	0.059	0.063	0.175	0.385	0.302	0.352	0.137	0.130	-0.035	0.310	0.224	0.352
VarWP3	**0.865**	0.628	0.800	**0.865**	0.496	0.681	0.705	0.155	0.137	0.352	0.287	0.347	0.281	0.147	0.230	-0.103	0.252	0.189	0.263
RT1	**0.905**	0.690	0.611	0.549	**0.905**	0.715	0.689	0.029	0.173	0.166	0.400	0.151	0.285	0.102	0.210	0.036	0.100	0.015	0.111
RT2	**0.962**	0.667	0.642	0.550	**0.962**	0.786	0.744	0.138	0.201	0.230	0.360	0.244	0.300	0.130	0.218	0.120	0.201	0.021	0.106
RT3	**0.959**	0.674	0.653	0.559	**0.959**	0.776	0.742	0.105	0.206	0.230	0.333	0.261	0.319	0.130	0.276	0.119	0.199	-0.012	0.102
RT4	**0.785**	0.468	0.408	0.377	**0.785**	0.486	0.495	0.143	0.118	0.186	0.284	0.162	0.280	0.093	0.095	0.225	0.195	0.056	0.192
RTF1	**0.887**	0.577	0.675	0.604	0.691	**0.887**	0.783	0.038	0.168	0.205	0.349	0.249	0.219	0.096	0.166	-0.062	0.143	0.015	0.066
RTF2	**0.938**	0.646	0.742	0.635	0.766	**0.938**	0.853	0.111	0.206	0.297	0.319	0.240	0.279	0.064	0.280	0.022	0.124	-0.029	0.009
RTF3	**0.846**	0.593	0.689	0.624	0.621	**0.846**	0.747	0.106	0.097	0.134	0.292	0.171	0.176	0.041	0.128	-0.059	0.116	0.050	0.064
RTF4	**0.949**	0.685	0.799	0.678	0.747	**0.949**	0.893	0.257	0.229	0.301	0.392	0.295	0.250	0.112	0.218	0.060	0.165	0.051	0.075
RTF5	**0.922**	0.667	0.775	0.678	0.688	**0.922**	0.819	0.129	0.192	0.342	0.358	0.352	0.308	0.202	0.332	-0.065	0.315	0.156	0.214
RTWP1	**0.869**	0.487	0.612	0.599	0.622	0.721	**0.869**	0.119	0.228	0.192	0.286	0.119	0.215	0.024	0.120	0.039	0.027	-0.060	-0.001
RTWP2	**0.957**	0.644	0.778	0.679	0.727	0.856	**0.957**	0.162	0.263	0.261	0.347	0.237	0.282	0.089	0.210	0.096	0.168	0.040	0.086
RTWP3	**0.932**	0.636	0.797	0.742	0.703	0.895	**0.932**	0.170	0.248	0.344	0.319	0.306	0.340	0.175	0.339	-0.049	0.172	0.066	0.129
ExtMv1	**0.997**	0.077	0.180	0.079	0.104	0.141	0.163	**0.997**	0.418	0.362	0.287	0.277	0.176	0.183	0.152	0.194	0.065	0.058	0.104
ExtMv2	**0.997**	0.093	0.176	0.081	0.119	0.147	0.167	**0.997**	0.420	0.367	0.317	0.276	0.173	0.170	0.152	0.197	0.094	0.071	0.120

Key: Var=Variation; VarF=Variation in Feature Use; VarWP= Variation in Work Processes; RT= Retention; RTF= Retention of Variations in Feature Use; ExtMv=Extrinsic Motivation; ExReg= External Regulation; IJReg= Introjected Regulation; IDReg= Identification Regulation; IntMv=Intrinsic Motivation; IMKnow= Intrinsic Motivation to Know; IMAcp= Intrinsic Motivation toward Accomplishment; IMSt= Intrinsic Motivation to Experience Stimulation; Peer=Peer Learning; RS=Perceived Resources; Knw=Domain-related Knowledge; KnwF=Knowledge of Feature; KnwWP= Knowledge of Work Processes; RS=Resources; TRN=Training; FBVL= Feedback Valence; Sat=Satisfaction; ExtUse=Extended Use; EmgUse=Emergent Use; IntUse=Integrative Use; INF=Infusion; RTN=Routinization

Table 6.6 Item Loadings and Cross Loadings for Constructs (Cont'd)

indicator	Factor Loading	RS	TRN	FBVL	Sat	ExtUse	EmgUse	IntUse	INF	RTN
Var1	**0.932**	0.104	-0.035	0.443	0.409	0.581	0.529	0.387	0.468	0.413
Var2	**0.976**	0.189	0.006	0.465	0.403	0.544	0.494	0.264	0.436	0.341
Var3	**0.971**	0.150	-0.031	0.440	0.383	0.547	0.486	0.254	0.409	0.354
VarF1	**0.906**	0.129	-0.010	0.295	0.322	0.506	0.505	0.356	0.382	0.345
VarF2	**0.903**	0.088	-0.012	0.200	0.289	0.380	0.434	0.189	0.277	0.243
VarF3	**0.825**	0.141	-0.062	0.225	0.249	0.383	0.367	0.333	0.246	0.297
VarF4	**0.942**	0.060	-0.078	0.264	0.329	0.469	0.539	0.333	0.371	0.265
VarF5	**0.908**	0.008	-0.085	0.298	0.343	0.444	0.633	0.375	0.380	0.264
VarWP1	**0.889**	0.103	0.031	0.221	0.306	0.396	0.365	0.283	0.312	0.352
VarWP2	**0.946**	0.176	0.038	0.285	0.365	0.434	0.394	0.295	0.380	0.411
VarWP3	**0.865**	0.107	-0.032	0.301	0.356	0.346	0.505	0.363	0.342	0.259
RT1	**0.905**	0.059	0.034	0.339	0.378	0.418	0.452	0.217	0.190	0.348
RT2	**0.962**	0.079	0.124	0.347	0.339	0.421	0.480	0.187	0.204	0.322
RT3	**0.959**	0.089	0.090	0.360	0.358	0.450	0.496	0.190	0.220	0.325
RT4	**0.785**	0.256	0.246	0.252	0.308	0.354	0.314	0.143	0.168	0.306
RTF1	**0.887**	-0.026	-0.056	0.296	0.269	0.433	0.512	0.226	0.163	0.379
RTF2	**0.938**	-0.048	-0.085	0.358	0.231	0.383	0.546	0.197	0.207	0.359
RTF3	**0.846**	-0.035	-0.134	0.189	0.167	0.268	0.398	0.177	0.205	0.305
RTF4	**0.949**	-0.032	-0.044	0.331	0.257	0.416	0.569	0.265	0.282	0.357
RTF5	**0.922**	0.023	-0.069	0.423	0.294	0.460	0.628	0.276	0.401	0.396
RTWP1	**0.869**	-0.086	-0.003	0.068	0.086	0.280	0.361	0.256	0.175	0.459
RTWP2	**0.957**	0.005	0.020	0.231	0.266	0.349	0.527	0.244	0.175	0.353
RTWP3	**0.932**	-0.042	-0.052	0.376	0.265	0.384	0.655	0.303	0.256	0.398
ExtMv1	**0.997**	0.054	0.160	0.152	0.064	0.157	0.237	0.266	0.089	0.168
ExtMv2	**0.997**	0.061	0.169	0.165	0.055	0.179	0.235	0.264	0.116	0.190

Key: Var=Variation; VarF=Variation in Feature Use; VarWP= Variation in Work Processes; RT= Retention; RTF= Retention of Variations in Feature Use; ExtMv=Extrinsic Motivation; ExReg= External Regulation; IJReg= Introjected Regulation; IDReg= Identification Regulation; IntMv=Intrinsic Motivation; IMKnow= Intrinsic Motivation to Know; IMAcp= Intrinsic Motivation toward Accomplishment; IMSt= Intrinsic Motivation to Experience Stimulation; Peer=Peer Learning; RS=Perceived Resources; Knw=Domain-related Knowledge; KnwF=Knowledge of Feature; KnwWP= Knowledge of Work Processes; RS=Resources; TRN=Training; FBVL= Feedback Valence; Sat=Satisfaction; ExtUse=Extended Use; EmgUse=Emergent Use; IntUse=Integrative Use; INF=Infusion; RTN=Routinization

Table 6.6 Item Loadings and Cross Loadings for Constructs (Cont'd)

indicator	Factor Loading	Var	VarF	VarWP	GRT	RTF	RTWP	ExtMV	ExREGv	IJREGv	IDREGv	IntMV	IMKnw	IMAcp	IMSt	Peer	Knw	KnwF	KnwWP
ExREGv1	**0.937**	0.212	0.196	0.127	0.225	0.232	0.315	0.346	**0.937**	0.594	0.597	0.366	0.369	0.327	0.357	0.099	0.039	0.095	0.104
ExREGv2	**0.929**	0.105	0.111	-0.034	0.146	0.140	0.192	0.444	**0.929**	0.502	0.482	0.269	0.097	0.311	0.264	0.083	0.053	0.067	0.064
ExREGv3	**0.922**	0.151	0.153	0.085	0.166	0.172	0.223	0.395	**0.922**	0.403	0.482	0.397	0.219	0.272	0.238	0.011	0.181	0.120	0.145
IJREGv1	**0.996**	0.209	0.238	0.209	0.224	0.280	0.290	0.362	0.543	**0.996**	0.529	0.489	0.427	0.550	0.503	0.152	0.152	0.147	0.133
IJREGv2	**0.996**	0.211	0.252	0.213	0.223	0.294	0.300	0.366	0.542	**0.996**	0.527	0.479	0.401	0.513	0.474	0.137	0.143	0.119	0.123
IDREGv1	**0.909**	0.486	0.425	0.373	0.339	0.356	0.330	0.347	0.499	0.499	**0.909**	0.461	0.513	0.496	0.356	0.005	0.376	0.397	0.421
IDREGv2	**0.852**	0.302	0.330	0.236	0.353	0.317	0.300	0.274	0.549	0.512	**0.852**	0.356	0.439	0.418	0.477	0.072	0.201	0.287	0.243
IDREGv3	**0.946**	0.440	0.377	0.355	0.344	0.349	0.306	0.195	0.492	0.428	**0.946**	0.427	0.528	0.509	0.387	0.029	0.333	0.357	0.391
IntMv1	**0.998**	0.349	0.319	0.302	0.233	0.284	0.245	0.281	0.384	0.487	0.461	**0.998**	0.516	0.497	0.474	0.230	0.359	0.292	0.120
IntMv2	**0.998**	0.357	0.336	0.325	0.223	0.300	0.252	0.273	0.359	0.482	0.461	**0.998**	0.508	0.494	0.454	0.225	0.368	0.300	0.128
IMKnw1	**0.932**	0.418	0.326	0.353	0.356	0.318	0.337	0.146	0.204	0.361	0.497	0.488	**0.932**	0.575	0.661	0.118	0.336	0.313	0.309
IMKnw2	**0.925**	0.226	0.258	0.263	0.247	0.188	0.234	0.180	0.277	0.412	0.521	0.464	**0.925**	0.589	0.666	0.194	0.339	0.313	0.393
IMAcp1	**0.985**	0.203	0.222	0.137	0.133	0.127	0.121	0.165	0.337	0.532	0.515	0.486	0.619	**0.985**	0.722	0.136	0.293	0.324	0.278
IMAcp2	**0.985**	0.208	0.173	0.133	0.117	0.104	0.099	0.183	0.309	0.519	0.524	0.493	0.616	**0.985**	0.690	0.138	0.310	0.346	0.324
IMSt1	**0.968**	0.208	0.220	0.145	0.212	0.230	0.219	0.112	0.313	0.451	0.442	0.457	0.720	0.683	**0.968**	-0.004	0.268	0.288	0.263
IMSt2	**0.976**	0.193	0.230	0.143	0.183	0.233	0.218	0.127	0.339	0.480	0.425	0.464	0.655	0.682	**0.976**	-0.030	0.299	0.311	0.230
IMSTv3	**0.959**	0.235	0.287	0.185	0.265	0.270	0.293	0.201	0.261	0.493	0.428	0.431	0.700	0.714	**0.959**	0.083	0.325	0.272	0.250
Peer1	**0.947**	0.111	0.014	-0.025	0.109	-0.029	0.019	0.168	0.008	0.126	0.013	0.225	0.166	0.134	-0.037	**0.947**	0.110	0.117	0.031
Peer2	**0.927**	0.031	-0.057	-0.140	0.138	-0.027	0.011	0.153	0.097	0.125	0.032	0.154	0.106	0.066	-0.006	**0.927**	0.046	0.030	-0.018
Peer3	**0.947**	0.022	-0.053	-0.158	0.102	-0.044	0.030	0.226	0.136	0.119	0.016	0.225	0.176	0.135	0.079	**0.947**	0.037	0.066	-0.060
Peer4	**0.971**	0.109	0.013	-0.051	0.145	0.015	0.040	0.190	0.035	0.175	0.074	0.248	0.176	0.177	0.024	**0.971**	0.135	0.114	0.014

Key: Var=Variation; VarF=Variation in Feature Use; VarWP= Variation in Work Processes; RT= Retention; RTF= Retention of Variations in Feature Use; ExtMv=Extrinsic Motivation; ExReg= External Regulation; IJReg= Introjected Regulation; IDReg= Identification Regulation; IntMv=Intrinsic Motivation; IMKnow= Intrinsic Motivation to Know; IMAcp= Intrinsic Motivation toward Accomplishment; IMSt= Intrinsic Motivation to Experience Stimulation; Peer=Peer Learning; RS=Perceived Resources; Knw=Domain-related Knowledge; KnwF=Knowledge of Feature; KnwWP= Knowledge of Work Processes; RS=Resources; TRN=Training; FBVL= Feedback Valence; Sat=Satisfaction; ExtUse=Extended Use; EmgUse=Emergent Use; IntUse=Integrative Use; INF=Infusion; RTN=Routinization

Table 6.6 Item Loadings and Cross Loadings for Constructs (Cont'd)

indicator	Factor Loading	RS	TRN	FBVL	Sat	ExtUse	EmgUse	IntUse	INF	RTN
ExREGv1	**0.937**	-0.041	0.081	0.093	0.167	0.219	0.235	0.211	0.134	0.306
ExREGv2	**0.929**	-0.023	0.052	0.045	0.091	0.179	0.184	0.201	0.103	0.191
ExREGv3	**0.922**	0.060	0.089	0.149	0.186	0.153	0.177	0.169	0.154	0.172
IJREGv1	**0.996**	-0.039	-0.003	0.235	0.201	0.341	0.366	0.333	0.264	0.302
IJREGv2	**0.996**	-0.015	0.020	0.246	0.194	0.336	0.371	0.325	0.284	0.290
IDREGv1	**0.909**	0.126	0.005	0.256	0.425	0.492	0.259	0.464	0.337	0.494
IDREGv2	**0.852**	0.169	0.107	0.283	0.468	0.368	0.335	0.312	0.131	0.248
IDREGv3	**0.946**	0.134	-0.022	0.243	0.479	0.446	0.193	0.313	0.223	0.387
IntMv1	**0.998**	-0.098	-0.156	0.284	0.342	0.326	0.453	0.355	0.279	0.238
IntMv2	**0.998**	-0.094	-0.163	0.276	0.333	0.319	0.433	0.346	0.281	0.241
IMKnw1	**0.932**	-0.027	-0.083	0.338	0.344	0.295	0.405	0.255	0.249	0.412
IMKnw2	**0.925**	0.125	-0.008	0.272	0.406	0.306	0.229	0.401	0.216	0.336
IMAcp1	**0.985**	-0.056	-0.161	0.244	0.376	0.354	0.316	0.373	0.204	0.153
IMAcp2	**0.985**	-0.045	-0.128	0.225	0.357	0.378	0.324	0.368	0.239	0.177
IMSt1	**0.968**	-0.090	-0.141	0.332	0.348	0.248	0.324	0.290	0.203	0.192
IMSt2	**0.976**	-0.107	-0.183	0.346	0.351	0.280	0.398	0.378	0.262	0.176
IMSTv3	**0.959**	-0.093	-0.143	0.378	0.339	0.361	0.404	0.386	0.240	0.219
Peer1	**0.947**	0.046	0.095	0.023	-0.144	0.077	0.039	0.031	0.099	-0.033
Peer2	**0.927**	0.053	0.167	0.068	-0.010	0.154	0.054	-0.016	0.001	-0.136
Peer3	**0.947**	-0.008	0.084	0.065	-0.078	0.131	0.088	0.075	0.061	-0.043
Peer4	**0.971**	0.069	0.096	0.090	-0.061	0.185	0.054	0.037	0.089	-0.011

Key: Var=Variation; VarF=Variation in Feature Use; VarWP= Variation in Work Processes; RT= Retention; RTF= Retention of Variations in Feature Use; ExtMv=Extrinsic Motivation; ExReg= External Regulation; IJReg= Introjected Regulation; IDReg= Identification Regulation; IntMv=Intrinsic Motivation; IMKnow= Intrinsic Motivation to Know; IMAcp= Intrinsic Motivation toward Accomplishment; IMSt= Intrinsic Motivation to Experience Stimulation; Peer=Peer Learning; RS=Perceived Resources; Knw=Domain-related Knowledge; KnwF=Knowledge of Feature; KnwWP= Knowledge of Work Processes; RS=Resources; TRN=Training; FBVL= Feedback Valence; Sat=Satisfaction; ExtUse=Extended Use; EmgUse=Emergent Use; IntUse=Integrative Use; INF=Infusion; RTN=Routinization

Table 6.6 Item Loadings and Cross Loadings for Constructs (Cont'd)

indicator	Factor Loading	Var	VarF	VarWP	GRT	RTF	RTWP	ExtMV	ExREGv	IJREGv	IDREGv	IntMV	IMKnw	IMAcp	IMSt	Peer	Knw	KnwF	KnwWP
Knw1	**0.979**	0.475	0.379	0.344	0.224	0.231	0.175	0.084	0.110	0.145	0.346	0.391	0.371	0.304	0.279	0.121	**0.979**	0.633	0.606
Knw2	**0.975**	0.413	0.309	0.261	0.145	0.146	0.097	0.071	0.073	0.144	0.320	0.317	0.338	0.293	0.324	0.050	**0.975**	0.640	0.605
KnwF1	**0.961**	0.376	0.331	0.326	0.092	0.150	0.123	0.087	0.168	0.177	0.434	0.335	0.364	0.377	0.272	0.130	0.614	**0.961**	0.631
KnwF2	**0.934**	0.222	0.163	0.075	-0.079	-0.074	-0.108	0.028	0.004	0.063	0.281	0.213	0.263	0.252	0.301	0.024	0.624	**0.934**	0.556
KnwWP1	**0.966**	0.277	0.229	0.319	0.100	0.071	0.060	0.105	0.099	0.137	0.370	0.124	0.371	0.287	0.272	-0.019	0.572	0.683	**0.966**
KnwWP2	**0.967**	0.307	0.244	0.354	0.161	0.118	0.102	0.112	0.119	0.112	0.392	0.116	0.359	0.303	0.223	0.002	0.627	0.537	**0.967**
RS1	**0.895**	0.183	0.141	0.123	0.059	-0.042	-0.057	0.058	0.040	0.052	0.193	-0.020	0.049	0.013	-0.049	-0.024	0.540	0.362	0.492
RS2	**0.813**	0.083	-0.027	0.027	-0.040	-0.170	-0.187	0.030	0.024	0.021	0.131	-0.092	0.033	0.064	-0.044	0.086	0.327	0.216	0.338
RS3	**0.909**	0.076	0.034	0.115	0.104	-0.014	-0.063	0.075	-0.036	-0.092	0.132	-0.139	0.009	-0.109	-0.164	0.051	0.257	0.223	0.337
RS4	**0.717**	0.189	0.170	0.261	0.231	0.145	0.130	-0.050	-0.096	-0.053	0.130	0.013	0.203	-0.086	-0.057	0.012	0.210	0.070	0.367
RS5	**0.839**	0.099	0.054	0.099	0.198	0.001	0.033	0.111	0.023	-0.077	0.042	-0.185	-0.061	-0.119	-0.109	0.082	0.187	0.145	0.299
TRN1	**0.949**	-0.013	-0.057	-0.010	0.070	-0.114	-0.061	0.153	0.050	0.005	0.065	-0.096	-0.076	-0.110	-0.186	0.163	0.129	0.241	0.213
TRN2	**0.954**	-0.027	-0.047	0.033	0.168	-0.046	0.031	0.161	0.102	0.010	-0.006	-0.205	-0.020	-0.167	-0.122	0.056	0.087	0.114	0.201
FBVL1	**0.945**	0.465	0.248	0.296	0.330	0.341	0.223	0.109	0.017	0.169	0.242	0.289	0.305	0.172	0.265	0.092	0.462	0.157	0.352
FBVL2	**0.949**	0.374	0.249	0.215	0.355	0.317	0.243	0.206	0.187	0.294	0.287	0.267	0.351	0.271	0.450	0.074	0.382	0.122	0.353
FBVL3	**0.960**	0.499	0.323	0.350	0.346	0.362	0.274	0.136	0.086	0.222	0.289	0.246	0.284	0.233	0.320	0.024	0.340	0.148	0.308
SAT1	**0.926**	0.432	0.335	0.414	0.412	0.266	0.219	0.063	0.080	0.126	0.479	0.300	0.392	0.341	0.248	-0.064	0.331	0.193	0.329
SAT2	**0.958**	0.385	0.341	0.387	0.394	0.277	0.246	0.061	0.181	0.183	0.463	0.336	0.396	0.353	0.356	-0.107	0.227	0.139	0.224
SAT3	**0.918**	0.398	0.283	0.339	0.317	0.221	0.164	0.043	0.162	0.189	0.544	0.294	0.340	0.332	0.306	-0.125	0.332	0.294	0.322
SAT4	**0.884**	0.311	0.304	0.258	0.276	0.231	0.233	0.053	0.178	0.244	0.365	0.321	0.359	0.347	0.420	0.017	0.218	0.129	0.137
ExtUse1	**0.789**	0.454	0.318	0.350	0.385	0.321	0.266	0.012	0.097	0.194	0.362	0.227	0.292	0.165	0.171	0.249	0.358	0.354	0.321
ExtUse2	**0.843**	0.469	0.455	0.374	0.480	0.447	0.449	0.240	0.306	0.378	0.452	0.315	0.281	0.271	0.294	0.262	0.399	0.327	0.301
ExtUse3	**0.801**	0.408	0.303	0.308	0.182	0.224	0.116	0.130	-0.008	0.133	0.318	0.245	0.245	0.366	0.201	-0.006	0.476	0.417	0.479
ExtUse4	**0.829**	0.559	0.495	0.384	0.419	0.408	0.354	0.146	0.225	0.374	0.439	0.260	0.244	0.395	0.320	-0.018	0.502	0.347	0.392

Key: Var=Variation; VarF=Variation in Feature Use; VarWP= Variation in Work Processes; RT= Retention; RTF= Retention of Variations in Feature Use; ExtMv=Extrinsic Motivation; ExReg= External Regulation; IJReg= Introjected Regulation; IDReg= Identification Regulation; IntMv=Intrinsic Motivation; IMKnow= Intrinsic Motivation to Know; IMAcp= Intrinsic Motivation toward Accomplishment; IMSt= Intrinsic Motivation to Experience Stimulation; Peer=Peer Learning; RS=Perceived Resources; Knw=Domain-related Knowledge; KnwF=Knowledge of Feature; KnwWP= Knowledge of Work Processes; RS=Resources; TRN=Training; FBVL= Feedback Valence; Sat=Satisfaction; ExtUse=Extended Use; EmgUse=Emergent Use; IntUse=Integrative Use; INF=Infusion; RTN=Routinization

Table 6.6 Item Loadings and Cross Loadings for Constructs (Cont'd)

indicator	Factor Loading	RS	TRN	FBVL	Sat	ExtUse	EmgUse	IntUse	INF	RTN
Knw1	**0.979**	0.366	0.091	0.405	0.294	0.527	0.289	0.383	0.687	0.164
Knw2	**0.975**	0.394	0.130	0.404	0.297	0.515	0.204	0.320	0.624	0.110
KnwF1	**0.961**	0.282	0.191	0.159	0.259	0.459	0.235	0.380	0.500	0.190
KnwF2	**0.934**	0.206	0.156	0.119	0.113	0.364	0.052	0.322	0.486	0.088
KnwWP1	**0.966**	0.435	0.230	0.326	0.265	0.396	0.126	0.375	0.389	0.284
KnwWP2	**0.967**	0.431	0.190	0.360	0.272	0.484	0.087	0.364	0.447	0.269
RS1	**0.895**	**0.895**	0.588	0.330	0.257	0.379	0.069	0.315	0.442	0.154
RS2	**0.813**	**0.813**	0.406	0.277	0.187	0.158	-0.070	0.158	0.252	-0.014
RS3	**0.909**	**0.909**	0.641	0.239	0.213	0.245	-0.069	0.079	0.227	0.105
RS4	**0.717**	**0.717**	0.339	0.264	0.203	0.149	-0.037	0.097	0.117	0.089
RS5	**0.839**	**0.839**	0.569	0.226	0.161	0.191	0.039	0.166	0.136	0.007
TRN1	**0.949**	0.542	**0.949**	0.078	0.095	0.271	0.047	0.182	0.221	0.026
TRN2	**0.954**	0.636	**0.954**	0.205	0.148	0.239	0.061	0.157	0.144	0.079
FBVL1	**0.945**	0.315	0.134	**0.945**	0.388	0.444	0.441	0.360	0.385	0.316
FBVL2	**0.949**	0.286	0.160	**0.949**	0.473	0.499	0.503	0.413	0.365	0.291
FBVL3	**0.960**	0.321	0.135	**0.960**	0.451	0.487	0.467	0.422	0.381	0.269
SAT1	**0.926**	0.342	0.210	0.449	**0.926**	0.444	0.308	0.307	0.254	0.264
SAT2	**0.958**	0.200	0.072	0.472	**0.958**	0.399	0.379	0.352	0.174	0.255
SAT3	**0.918**	0.232	0.142	0.365	**0.918**	0.502	0.312	0.326	0.312	0.214
SAT4	**0.884**	0.130	0.039	0.412	**0.884**	0.400	0.441	0.342	0.216	0.148
ExtUse1	**0.789**	0.219	0.236	0.391	0.312	**0.789**	0.321	0.384	0.476	0.431
ExtUse2	**0.843**	0.189	0.249	0.398	0.383	**0.843**	0.505	0.519	0.443	0.340
ExtUse3	**0.801**	0.349	0.245	0.457	0.424	**0.801**	0.343	0.538	0.603	0.362
ExtUse4	**0.829**	0.193	0.152	0.397	0.421	**0.829**	0.505	0.504	0.573	0.273

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Table 6.6 Item Loadings and Cross Loadings for Constructs (Cont'd)

indicator	Factor Loading	Var	VarF	VarWP	GRT	RTF	RTWP	ExtMV	ExREGv	IJREGv	IDREGv	IntMV	IMKnw	IMAcp	IMSt	Peer	Knw	KnwF	KnwWP
EmgUse1	**0.802**	0.415	0.491	0.410	0.472	0.516	0.504	0.241	0.125	0.263	0.254	0.292	0.217	0.241	0.213	0.005	0.154	0.038	0.094
EmgUse2	**0.854**	0.408	0.447	0.381	0.522	0.554	0.539	0.146	0.192	0.234	0.214	0.321	0.300	0.195	0.292	0.092	0.186	0.051	0.053
EmgUse3	**0.847**	0.490	0.505	0.416	0.490	0.600	0.551	0.209	0.289	0.375	0.363	0.475	0.286	0.314	0.403	0.098	0.202	0.202	0.122
EmgUse4	**0.870**	0.493	0.471	0.438	0.401	0.461	0.462	0.266	0.177	0.299	0.228	0.332	0.341	0.263	0.295	0.022	0.253	0.076	0.135
EmgUse5	**0.831**	0.435	0.478	0.365	0.319	0.408	0.425	0.156	0.093	0.268	0.126	0.354	0.298	0.247	0.315	0.040	0.260	0.174	0.015
EmgUse6	**0.822**	0.389	0.403	0.347	0.228	0.403	0.385	0.164	0.187	0.411	0.236	0.443	0.282	0.367	0.424	0.051	0.224	0.274	0.125
IntUse1	**0.918**	0.293	0.357	0.344	0.225	0.275	0.307	0.270	0.245	0.376	0.411	0.331	0.339	0.396	0.380	0.050	0.351	0.375	0.381
IntUse2	**0.972**	0.302	0.338	0.320	0.176	0.232	0.265	0.266	0.247	0.324	0.435	0.340	0.323	0.370	0.347	0.072	0.354	0.376	0.380
IntUse3	**0.959**	0.328	0.372	0.353	0.225	0.254	0.297	0.249	0.200	0.245	0.377	0.308	0.302	0.277	0.298	-0.016	0.335	0.381	0.348
IntUse4	**0.882**	0.388	0.362	0.371	0.246	0.322	0.312	0.198	0.097	0.218	0.355	0.336	0.334	0.316	0.298	-0.026	0.384	0.353	0.345
IntUse5	**0.950**	0.254	0.291	0.301	0.149	0.184	0.227	0.286	0.235	0.383	0.384	0.360	0.345	0.403	0.373	0.067	0.309	0.319	0.356
IntUse6	**0.937**	0.197	0.261	0.261	0.115	0.140	0.219	0.221	0.145	0.308	0.309	0.293	0.330	0.350	0.349	0.059	0.284	0.281	0.330
INF1	**0.816**	0.376	0.336	0.314	0.309	0.312	0.274	0.167	0.114	0.263	0.213	0.264	0.326	0.238	0.266	0.124	0.516	0.388	0.272
INF2	**0.864**	0.438	0.367	0.368	0.179	0.249	0.238	0.056	0.179	0.248	0.318	0.236	0.293	0.244	0.219	0.062	0.626	0.478	0.401
INF3	**0.754**	0.205	0.118	0.173	-0.007	0.042	-0.033	-0.123	-0.013	0.023	0.028	0.114	-0.066	0.003	0.007	-0.041	0.504	0.352	0.324
INF4	**0.954**	0.455	0.382	0.388	0.241	0.301	0.244	0.140	0.216	0.319	0.318	0.293	0.307	0.294	0.290	0.093	0.662	0.540	0.466
INF5	**0.882**	0.462	0.379	0.402	0.151	0.272	0.200	0.071	0.054	0.198	0.197	0.264	0.180	0.148	0.194	0.022	0.577	0.510	0.406
INF6	**0.915**	0.413	0.333	0.346	0.221	0.260	0.195	0.152	0.122	0.307	0.230	0.266	0.190	0.183	0.226	0.075	0.599	0.413	0.374
INF7	**0.671**	0.102	-0.017	0.029	-0.116	-0.075	-0.140	-0.099	0.022	0.026	-0.014	0.048	-0.128	-0.027	-0.014	-0.082	0.441	0.313	0.255
RTN1	**0.915**	0.398	0.305	0.388	0.367	0.404	0.431	0.200	0.248	0.294	0.439	0.242	0.358	0.136	0.108	0.005	0.168	0.176	0.321
RTN2	**0.951**	0.332	0.240	0.335	0.320	0.348	0.370	0.124	0.176	0.235	0.325	0.155	0.372	0.156	0.171	-0.015	0.138	0.169	0.338
RTN3	**0.963**	0.378	0.289	0.385	0.317	0.377	0.406	0.136	0.229	0.242	0.426	0.227	0.359	0.149	0.145	-0.082	0.132	0.154	0.302
RTN4	**0.858**	0.385	0.364	0.321	0.351	0.372	0.411	0.231	0.279	0.354	0.437	0.304	0.438	0.216	0.323	-0.033	0.145	0.144	0.152
RTN5	**0.951**	0.273	0.237	0.313	0.288	0.321	0.375	0.118	0.193	0.228	0.310	0.154	0.324	0.098	0.171	-0.141	0.055	0.054	0.223

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Table 6.6 Item Loadings and Cross Loadings for Constructs (Cont'd)

indicator	Factor Loading	RS	TRN	FBVL	Sat	ExtUse	EmgUse	IntUse	INF	RTN
EmgUse1	**0.802**	0.030	0.099	0.345	0.379	0.453	**0.802**	0.375	0.291	0.307
EmgUse2	**0.854**	-0.002	0.060	0.418	0.296	0.442	**0.854**	0.376	0.259	0.253
EmgUse3	**0.847**	-0.089	0.057	0.410	0.315	0.542	**0.847**	0.457	0.320	0.324
EmgUse4	**0.870**	0.069	0.084	0.502	0.425	0.411	**0.870**	0.454	0.342	0.310
EmgUse5	**0.831**	0.021	0.002	0.377	0.296	0.347	**0.831**	0.463	0.324	0.212
EmgUse6	**0.822**	-0.056	-0.023	0.431	0.231	0.403	**0.822**	0.527	0.302	0.285
IntUse1	**0.918**	0.243	0.202	0.382	0.378	0.614	0.471	**0.918**	0.526	0.480
IntUse2	**0.972**	0.231	0.160	0.400	0.340	0.585	0.478	**0.972**	0.506	0.532
IntUse3	**0.959**	0.225	0.197	0.399	0.366	0.580	0.493	**0.959**	0.497	0.507
IntUse4	**0.882**	0.144	0.122	0.396	0.327	0.566	0.591	**0.882**	0.499	0.561
IntUse5	**0.950**	0.176	0.174	0.399	0.306	0.511	0.468	**0.950**	0.430	0.446
IntUse6	**0.937**	0.146	0.139	0.377	0.290	0.492	0.456	**0.937**	0.383	0.476
INF1	**0.816**	0.212	0.217	0.326	0.262	0.637	0.407	0.467	**0.816**	0.410
INF2	**0.864**	0.206	0.120	0.198	0.216	0.550	0.356	0.446	**0.864**	0.342
INF3	**0.754**	0.220	0.061	0.226	0.003	0.339	0.035	0.191	**0.754**	-0.027
INF4	**0.954**	0.344	0.219	0.437	0.350	0.650	0.393	0.522	**0.954**	0.246
INF5	**0.882**	0.295	0.141	0.403	0.147	0.530	0.301	0.510	**0.882**	0.278
INF6	**0.915**	0.288	0.183	0.447	0.320	0.587	0.360	0.450	**0.915**	0.169
INF7	**0.671**	0.212	0.119	0.146	-0.103	0.228	-0.103	0.134	**0.671**	-0.082
RTN1	**0.915**	0.074	0.059	0.261	0.150	0.386	0.328	0.462	0.241	**0.915**
RTN2	**0.951**	0.118	0.086	0.276	0.132	0.394	0.272	0.466	0.267	**0.951**
RTN3	**0.963**	0.115	0.052	0.288	0.222	0.414	0.270	0.480	0.263	**0.963**
RTN4	**0.858**	0.054	0.030	0.320	0.397	0.424	0.430	0.594	0.295	**0.858**
RTN5	**0.951**	0.070	0.032	0.265	0.178	0.331	0.236	0.453	0.238	**0.951**

Key: Var=Variation; VarF=Variation in Feature Use; VarWP= Variation in Work Processes; RT= Retention; RTF= Retention of Variations in Feature Use; ExtMv=Extrinsic Motivation; ExReg= External Regulation; IJReg= Introjected Regulation; IDReg= Identification Regulation; IntMv=Intrinsic Motivation; IMKnow= Intrinsic Motivation to Know; IMAcp= Intrinsic Motivation toward Accomplishment; IMSt= Intrinsic Motivation to Experience Stimulation; Peer=Peer Learning; RS=Perceived Resources; Knw=Domain-related Knowledge; KnwF=Knowledge of Feature; KnwWP= Knowledge of Work Processes; RS=Resources; TRN=Training; FBVL= Feedback Valence; Sat=Satisfaction; ExtUse=Extended Use; EmgUse=Emergent Use; IntUse=Integrative Use; INF=Infusion; RTN=Routinization

6.3.3 Structural Model Assessment

The statistical results in the previous section indicated that the measurement model demonstrated satisfactory reliability and validity. This section presents the results of the hypothesized structural model analysis. Bootstrapping using 1000 samples was used to evaluate the strength of the structural paths, and the product-indicator approach used to assess the interaction effect (Chin, Marcolin, & Newsted, 2003).

6.3.4 Hypotheses Testing- Main Model

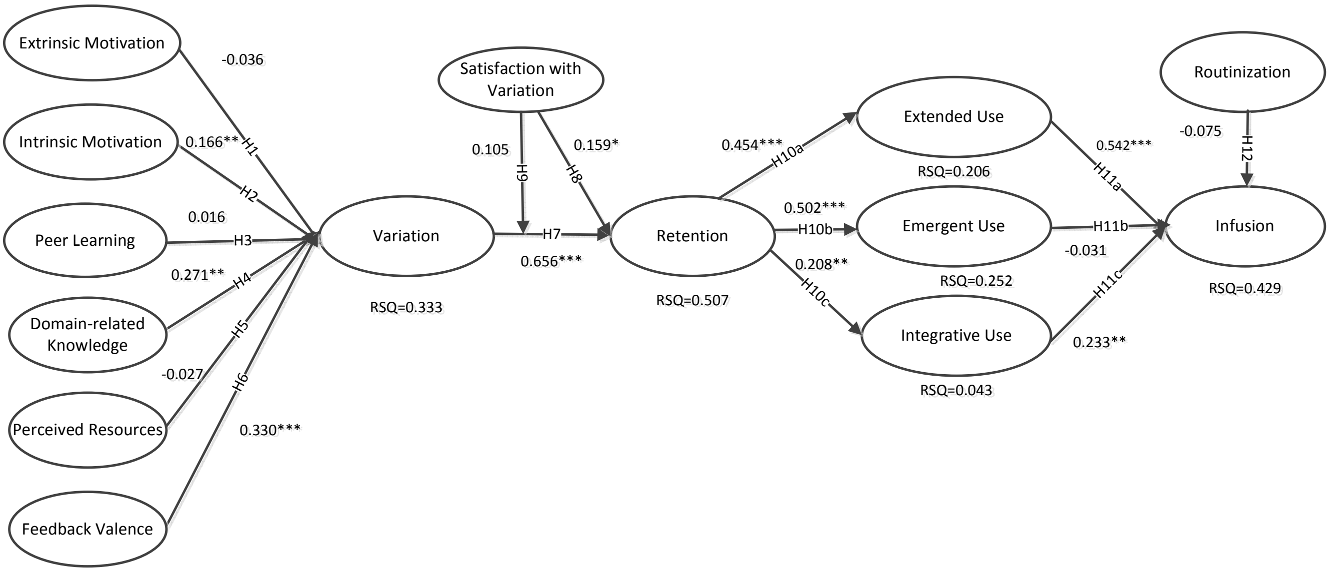
Figure 6.1 shows the results for the structural model. The results showed that the model accounted for 0.333 of the variance explained for variation. Intrinsic motivation (0.166, $p \leq 0.05$), domain-related knowledge (0.271, $p \leq 0.05$) and feedback valence (0.330, $p \leq 0.001$) were shown to be positively related to variation: Hypotheses H2, H4 and H6 were therefore supported significantly. However, contrary to expectations the results did not provide support for the links between variations and, extrinsic motivation (-0.036), peer learning (0.016) and perceived resources (-0.027). Hypotheses H1, H4 and H6 were therefore not supported.

Turning to the impacts on retention, the results show that variation, satisfaction with variations, and the moderating effect of satisfaction with variation accounted for 0.507 of the variance explained for retention; Hypothesis H7 concerning the link between variation and retention (0.656, $p \leq 0.001$) was strongly supported suggesting that greater variety in one's use will have a positive effect on retention. The results also showed support for the links between satisfaction with variation and retention (Hypothesis H8) (0.159, $p \leq 0.10$). The results however did not provide support for the link between retention and the moderating effect of satisfaction with variation (0.105). Hypothesis H9 was therefore not supported.

Further investigations of the effect of retention on deeper use types revealed that retention had a strong, positive and significant impact on extended use (0.454, $p \leq 0.001$), emergent use (0.502 $p \leq 0.001$) and integrative use (0.208, $p \leq 0.05$), accounting for variance explained of 0.206, 0.252, 0.043, respectively. Hypotheses H10a to H10c was therefore supported.

Finally, the model explained 0.429 of the variance explained for infusion. The results showed the links between extended use (0.542, $p \leq 0.001$) and integrated use (0.233, $p \leq 0.05$), and infusion were significant and positive; Hypotheses H11a and H11c were thus supported. However contrary to expectations, neither emergent use (-0.031) nor routinization (-0.075) were significant with respect to infusion; hypotheses H11b and H12 were not supported. See Figure 6.1.

Figure 6.1 Structural Model (Results)



Key: *** p≤0.001; **p≤0.05; *p≤0.10

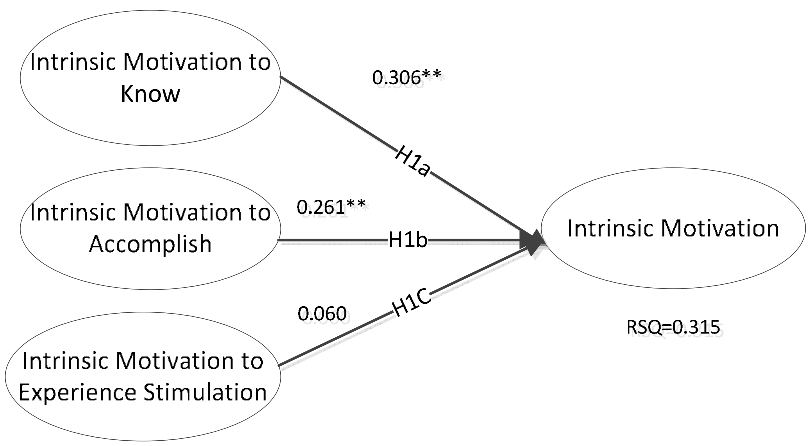
6.3.5 Hypotheses Testing- Sub-Dimensions

Following the tests of the main effects, this section reports the results of the sub-dimensions and components of the overall constructs, specifically, extrinsic motivation, intrinsic motivation, domain-related knowledge, perceived resources, variation and retention.

6.3.5.1 Intrinsic Motivation

Figure 6.2 shows the results for the structural model for intrinsic motivation to perform variations. The results showed that the model accounted for 0.315 of the variance explained for intrinsic motivation (IM). Intrinsic motivation to know (0.306, p≤0.05) and intrinsic motivation toward accomplishment (0.261, p≤0.05) were shown to be significantly and positively related to intrinsic motivation, thus supporting Hypotheses H1a and H1b. The results however did not provide support for the link between IM to experience stimulation and IM (0.060). Hypothesis H1c were therefore not supported.

Figure 6.2. Intrinsic Motivation: Structural Model (Results)

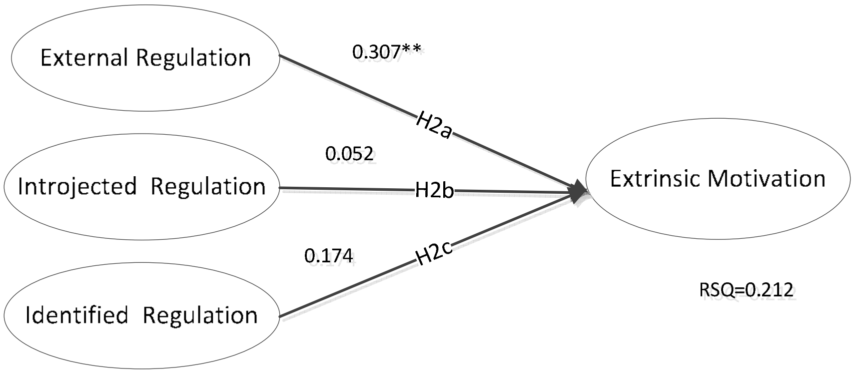


Key: *** p≤0.001; **p≤0.05; *p≤0.10

6.3.5.2 Extrinsic Motivation

Figure 6.3 shows the results for the structural model for extrinsic motivation to perform variations. The results showed that the model accounted for 0.212 of the variance explained for extrinsic motivation (EM). External Regulation (0.307, p≤0.05) was shown to be significantly and positively related to extrinsic motivation, thus Hypotheses H2a was supported. However, the results did not provide support for the relationship between extrinsic motivation, and introjected regulation (0.052) and identified regulation (0.174). Hypotheses H2b and H2c were therefore not supported.

Figure 6.3. Extrinsic Motivation: Structural Model (Results)

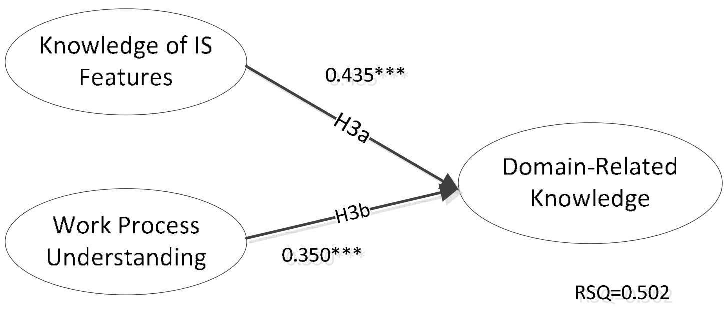


Key: *** p≤0.001; **p≤0.05; *p≤0.10

6.3.5.3 Domain-related knowledge

Figure 6.4 shows the results for the structural model for domain-related knowledge to perform variation. The results showed that the model accounted for 0.502 of the variance explained for domain-related knowledge. Knowledge of IS features (0.435, p≤0.001) and work process understanding (0.350, p≤0.001) were shown to be positively and significantly related to domain-related knowledge; thus hypotheses H3a and H3b were supported.

Figure 6.4 Domain-related knowledge: Structural Model (Results)

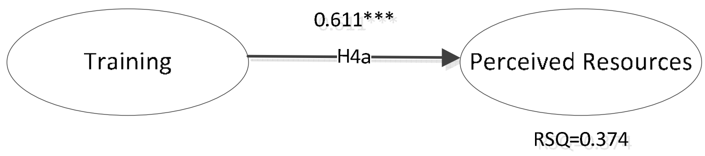


Key: *** p≤0.001; **p≤0.05; *p≤0.10

6.3.5.4 Perceived Resources

Figure 6.5 shows the results for the structural model for perceived resources for performing variations. Training (0.611 $p \leq 0.001$) was shown to be positively and significantly related to perceived resources, accounting for 0.374 of the variance explained for perceived resources; H4a was therefore supported.

Figure 6.5 Perceived Resources: Structural Model (Results)

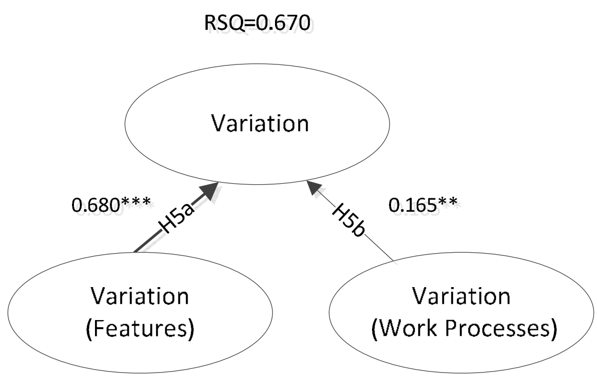


Key: *** $p \leq 0.001$; **$p \leq 0.05$; *$p \leq 0.10$

6.3.5.5 Variation

Figure 6.6 shows the results for the structural model for overall variation. The results showed that the model accounted for 0.670 of the variance explained for overall variations. Variation in Feature Use (0.680, $p \leq 0.001$) and Variations in Work Processes (to accommodate the IS) (0.165, $p \leq 0.05$) were shown to be significant components of overall variation. Hypotheses H5a and H5b were therefore supported.

Figure 6.6 Forms of Variations: Structural Model (Result)

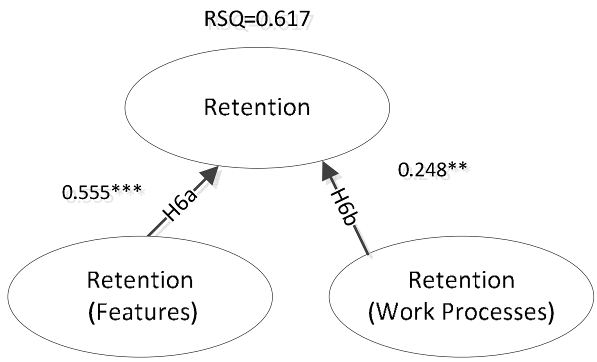


Key: *** $p \leq 0.001$; **$p \leq 0.05$; *$p \leq 0.10$

6.3.5.6 Retention

Figure 6.7 shows the results for the structural model overall retention. The results showed that the model accounted for 0.617 of the variance explained for overall retention. Retention of variations in Feature Use (0.555, $p \leq 0.001$) and Retention of Variations in Work Processes (to accommodate the IS) (0.248, $p \leq 0.05$) were shown to be significant components of overall retention. Hypotheses H6a and H6b were therefore supported.

Figure 6.7 Forms of Retention: Structural Model (Result)



Key: *** $p \leq 0.001$; ** $p \leq 0.05$; * $p \leq 0.10$

6.4 Common Method Bias

There are several recommended approaches and procedures for reducing or accounting for common method biases. These include 'preventative' procedures aimed at minimizing bias (Podsakoff, MacKenzie, Lee, & Podsakoff, 2003), and statistical techniques for detecting and controlling for the effects of bias during the data analysis (Chin, Thatcher, & Wright, 2012; Chin, Thatcher, Wright, & Steel, 2013). In this study, both procedural and statistical remedies to address the common method effects were applied. First, the procedural techniques are discussed.

Podsakoff et al (2003) recommend a number of procedures for reducing common method bias, which may be divided into five categories. These are (1) obtaining measures of the predictor and criterion variables from different sources, (2) temporal, proximal, psychological and methodological separation of measurement, (3) counterbalancing the question order, (4), protecting respondent anonymity, and (5) improving scale items. These procedures normally take place during the design phase of the study and survey instrument development.

This study followed both temporal and measurement separation guidelines by (i) measuring variation, retention and other dependent variables and their hypothesized predictors in different sections of the survey, interjected with other items in the survey, and (ii) using different response formats, that is, a combination of semantic differential, Likert scales, and percentage scales to capture constructs.

It is also possible to reduce method biases through the careful construction of the items themselves. For example, Tourangeau (2000) recommended some 'practical' advice for questionnaire design in order to reduce item ambiguity such as (a) defining ambiguous or unfamiliar terms; (b) avoiding vague concepts and provide examples when such concepts must be used; (c) keeping questions simple, specific, (d) decomposing questions relating to more than one possibility into simpler questions. These guidelines were used in the design of the survey to reduce common method bias.

For example, the survey provided definitions and brief explanations of concepts where necessary. For instance, the survey introduced the term 'variation' which was unfamiliar and had a specific meaning in this study. Thus, a definition of the term 'variation' along with examples, were included at the beginning of the survey; an abbreviated form of the definition was also added as a footnote on all relevant pages of the survey. Also, although the survey population was made up of users familiar with a specific software product, technical jargon such as 'Information Systems' was avoided, as the pre-test indicated that this was not a familiar term for most users; the term 'IT/Computer System' was used instead.

Also, another way to diminish method biases is to use different scale end-points and formats for the predictor and criterion measures (Podsakoff et al., 2003), which was applied in this research. In this study, different anchor points were used for the predictor and criterion variables. For instance, for variation, 7-point Likert scales ranging from 'None at all to 'A Great Amount' was used; while for the enablers and/or triggers, 7-point Likert scales ranging from 'Strongly Disagree' to 'Strongly Agree' was used. It is argued that this can reduce method biases caused by commonalities in scale end-points and anchoring effects (Podsakoff et al., 2003). Also, verbal labels (Podsakoff et al., 2003) were included at the beginning, middle and end points of each scale, along with 'arrows' as visual cues to guide the respondents.

Some researchers reduce such common method biases by controlling for priming effects and item-context induced mood states by counterbalancing the order of the measurement of the predictor and criterion variables. To prevent respondents from easily combining related items, one option is to randomize the order of the questions (Chang, van Witteloostuijn, & Eden, 2010). In this research, questions measuring predictor variables and criterion variables were kept separate. During the pre-test, questions were randomized across groups; however, this was not well-received by the respondents, who on recognizing that some questions were similar were annoyed by the format. Although not ideal, the alternative that was used in this study (and accepted by respondents during the pre-test) was to group the questions for each construct, but use multiple sections and mix the order of the groups within the sections. This was considered acceptable since a number of other tactics were being implemented to address bias, and the study was not wholly reliant on this particular procedure.

Furthermore, to reduce common method variance, a researcher may obtain measures of predictors and criterion variables from separate sources (Podsakoff et al., 2003). However, it was not deemed to be feasible in this study to collect data on predictor variables (such as intrinsic/extrinsic motivation and feedback valence) and criterion variables (such as variation and retention) from different sources. Since both sets of variables were largely perceptual or could not be obtained other than through personal judgment, self-reports were considered the best source of respondents' data. The rationale for using self-reports is based on the stance of the researcher that the users themselves were best suited to respond to the survey questions, as they are most aware of the actions that they engage in over time as they use the IS and the factors that trigger, enable or hinder such actions.

This research also applied statistical techniques to detect and where possible, to control for common method bias. Specifically, Harman's one-factor test (Podsakoff et al., 2003) and the measured marker variable technique (MLMV) proposed by Chin and associates (Chin, Thatcher, et al., 2012; Chin et al., 2013) were applied. Harman's one-factor test (Podsakoff et al., 2003) was performed on the 94 items used to assess the research model. The results showed that no single factor accounted for more than 0.280 of the variance, suggesting that common method bias was unlikely to be a significant concern for this study.

Besides the Harman's one-factor test, which is aimed at detecting bias, this study also applied the recently developed statistical technique referred to as the Measured Latent Marker Variable (MLMV) approach which has the potential not only to detect bias but also to control for it (Chin, Thatcher, et al., 2012; Chin et al., 2013). To date, a number of methods and techniques have been suggested for detecting and controlling the common method variance (CMV) in statistical analyses including PLS analyses (Chin, Thatcher, et al., 2012). Most include the frequently used technique of unmeasured latent marker variable (Liang, Xue, Ke, & Wei, 2010); however, this has been shown to be incapable of fully detecting the CMV in PLS analyses (Chin, Thatcher, et al., 2012; Chin et al., 2013). More recently, Chin et al. (2013) suggested that the measured latent marker variable approach if applied appropriately is capable of controlling for up to 100% of the common method variance.

To implement the MLMV approach, the researcher will need to collect multiple unrelated measures at the time of data collection for the primary research model (Chin et al., 2013). It is suggested that these items should not be related to any construct of interest within the primary research model, but should maintain the same format and scale that has been used in the survey (Chin et al., 2013). These items are intended to capture existing common method variance, if any. Chin et al. (2013) recommended that, ideally, one should use 12 items to estimate MLMV, but noted also that CMV can be detected and reduced by more than 70% using as few as 4 items. Their evaluation of the technique using from 1 to 12 items showed that at least 4 items were needed to effectively detect and control for existing CMV and allow researchers to partial out up to 72 percent of variance due to CMV.

Given the sample limitations, this research selected and used 4 items designed to have the least possible logical correlation with other constructs investigated in the research. The 4 items were: (1) Music is important in my life; (2) Group meetings are usually inefficient; (3) People should shop at locally owned stores, and (4) Mountains make a great destination for a vacation. Responses were captured using 7-point Likert scales with the end-points labelled as (1) Strongly Disagree and (7) Strongly Agree.

Two approaches are recommended for applying the MLMV items in a PLS model. These are construct level correction (CLC) and item level correction (ILC) (Chin et al., 2012). This study used the item level correction (ILC) procedure described in Chin et al. (2013). Even though it is more tedious than CLC to implement, it is the more accurate of the two approaches and allows for estimates of the item loadings as well as the structural paths.

The item level correction (ILC) approach uses MLMV items to partial out and remove the CMV effects at the measurement item level (Chin et al., 2013). To conduct ILC, each item measure was regressed on the entire set of MLMV items and the regression residuals (i.e. standardized residuals) saved. The residuals for each item now represent the construct items with the CMV effects removed. In order to obtain an assessment of the reliability of the original items in capturing the underlying construct of interest, the R-square obtained from each item to MLMV regression is used (Chin et al., 2013). Particularly, the square root of the R-square is multiplied by the standardized error and added to each item residual. The results represent the final ILC items that were then used in the PLS analysis to derive the corrected estimates. Table 6.7 reports the estimates for the main structural model (See Figure 6.1) for item level correction as compared to the original estimates.

The results (Table 6.7) show that both the variance explained (i.e. R-square estimates) and the path estimates from the ILC analysis are largely consistent with the original estimates. While there are small differences in the magnitude of the path estimates when comparing the original with the corrected estimates (i.e. on average the original estimates are 4% higher than the ILC estimates), there is little or no difference in the significance levels. More specifically, paths that were significant under the original analysis remained significant using item level correction (e.g. intrinsic motivation and domain-related knowledge, and variation; and retention to extended use, emergent use, and integrated use). Likewise, path estimates that were <u>not</u> significant under the original analysis are also not significant with item level correction (e.g. extrinsic motivation, peer learning and perceived resources, to variation). The only noteworthy differences are the path estimates for integrated use to infusion, which increased from 0.233 ($p \leq 0.05$) to 0.318 ($p \leq 0.001$) with item level correction, and routinization to infusion, which became significant though inverse with item level correction (-0.156, $p \leq 0.05$) when compared with the original estimate (0.075, $p > 0.10$). The latter, however, is consistent with post-hoc analysis (using bootstrapping and a sample size of 258, that is, 3 times the original sample size) which suggests that with a larger sample the link between routinization and infusion is likely to be significant and inverse ($p \leq 0.05$).

Given the consistency between the results after correcting for CMV effects and the original estimates, it was determined that common method variance though present did not have a significant impact on the study findings. The next chapter will therefore discuss the results of the tests of the structural model in conjunction with the extant literature.

Table 6.7. Results of Item Level Correction (ILC) Approach for CMV versus Original PLS Analysis

	ILC Estimates	Original PLS Estimates
H1: Extrinsic Motivation → Variation	-0.026^{ns}	-0.036^{ns}
H2: Intrinsic Motivation → Variation	0.161**	0.166**
H3: Peer Learning → Variation	0.011^{ns}	0.016^{ns}
H4: Domain-Related Knowledge → Variation	0.258**	0.271**
H5: Perceived Resources → Variation	-0.026^{ns}	-0.027^{ns}
H6: Feedback Valence → Variation	0.317***	0.330***
R-Square (Variation)	**0.307**	**0.333**
H7: Variation → Retention	0.647***	0.656***
H8: Satisfaction → Retention	0.167*	0.159*
H9: Satisfaction-Variation Interaction → Retention	0.122^{ns}	0.105^{ns}
R-Square (Retention)	**0.492**	**0.507**
H10a: Retention → Extended Use	0.468***	0.454***
H10b: Retention → Emergent Use	0.522***	0.502***
H10c: Retention → Integrated Use	0.224**	0.208**
R-Square (Extended Use)	**0.219**	**0.206**
R-Square (Emergent Use)	**0.273**	**0.252**
R-Square (Integrated Use)	**0.050**	**0.043**
H11a: Extended Use → Infusion	0.506***	0.542***
H11b: Emergent Use → Infusion	-0.018^{ns}	-0.031^{ns}
H11c: Integrated Use → Infusion	0.318***	0.233**
H12: Routinization → Infusion	-0.156^{ns}	-0.075^{ns}
R-Square (Infusion)	**0.443**	**0.429**

Key: *** $p \leq 0.001$; ** $p \leq 0.05$; * $p \leq 0.10$

6.5 Chapter Reflection

This chapter detailed the methodology used in the quantitative analysis phase, which included instrument development, data collection and data analysis. The survey incorporated both new and existing measures to test the constructs in the model. A series of pre-tests were used to evaluate the content of the survey, and items were adjusted accordingly to ensure clarity. The main data collection yielded 86 responses, which were used to analyse the measurement and structural model. The following chapter will now provide a summary of the main findings and discuss the findings in light of the extant literature.

Chapter 7. Discussion

"Discussion is an exchange of knowledge; an argument an exchange of ignorance." [Robert Quillen]

7.1 Chapter Overview

The aim of this research is to provide a comprehensive yet parsimonious explanation of how individuals' use of IS changes over time in an organizational context. For this study, Generalized Darwinism provided a meta-theoretical structure of overarching principles (that is, variation, selection and retention), coupled with auxiliary theories, which was used to inform the theoretical model presented in Figure 5.1. This chapter discusses the findings from the case studies along with those from the survey.

The case study findings in particular are quite rich compared with the survey, with users interviewed from across three (3) organizations in three (3) different industries - Agriculture, Energy and Communications, using distinct systems, that is, a Customer Relationship Management System, Information Technology Service Management and Collaboration System, respectively. Further, in each organisation a range of users (that is basic, intermediate and advanced users) were interviewed, as well as the CIO (or representative) and an IS trainer or other IS personnel with in-depth knowledge of the System under investigation. Reference to system documentation and system walkthroughs also aided the data collection process, and provided further insights into the focal Systems and how they were used in the organisation. On the other hand, the survey findings, though insightful, were more constrained, as the data collection focused on a single organisation (i.e. a university), and a single set of users, that is, academics (albeit, basic, intermediate and advanced users) using a single type of System (i.e. Learning Management System)

7.2 Discussion of Research Findings

In this section, the findings of the case interviews and survey are discussed in relation to the underlying research questions, and previous research.

RQ 1a. What behaviours (or actions) underpins individuals' change in IS use?

Evolutionary change entails a continuous cycle of *variation*, *selection* and *retention* among entities in a designated population (Van de Ven & Poole, 1995). Geoffrey Hodgson and associates proposed a meta-theoretical framework, that is, '*Generalized Darwinism*', for describing and understanding change by applying a generalization of the basic Darwinian concepts of variation, selection and retention to non-biological domains (Aldrich, et al., 2008; Hodgson & Knudsen, 2006).

Variation is an essential part of the process, and is often dubbed the 'raw material for evolution, as if there is no variation, then there are no alternatives to select from (Mayr, 1991). In a general sense, applied to non-biological domains, variation can be defined as "any departure from routine or tradition" (Aldrich, 1999, p. 22), or the "generation of new ways of doing things" (Furneaux et al., 2010, p. 4). *Selection* refers to forces that differentially select or selectively eliminate certain types of variations generate a second essential evolutionary process while in *retention,* selected variations are then preserved, duplicated, or otherwise reproduced (Aldrich, 1999).

In this research, Generalized Darwinism was used to frame and examine changes in how an IS is used to support one's work. In terms of what actually evolved, the focus was on individual use of the IS, with an emphasis on their enactment of organizational routines, that is, the performative aspect of the routine (Feldman & Pentland, 2003). Thus in observing change in IS use, this research focused on the IS-enabled routine by applying elements of variation, selection and retention to explain changes in individuals' use of IS to perform their work routines.

The findings revealed that change in IS use indeed occurred via variation, selection and retention, which provided support for the evolutionary mechanism as a potential lens for understanding changes for post-adoption IS use.

In this research, 'variation' was defined as experiments with (i) different ways of using the System features to support one's work and/or (ii) different ways to do one's work to accommodate the System. The case findings revealed that variations included (i) *using formerly unused (available) features,* (ii) *modifying use of currently used set of features,* (iii) *substituting or replacing one (already-used) feature with another feature* and (iv) *finding novel or innovative uses* of IS features. All interviewees engaged in some form of variation, with using formerly unused (available) features being the most common form of variation, followed by modifying use of currently used set of features, then substituting features, then finding innovative or new uses of features. Evidence of Variations in feature use as a significant component of Variation was also found in the survey findings (0.680, $p \leq 0.001$). Both findings are consistent with prior research (Sun, 2012) which argues that indeed individuals revise their use of System features by altering the set of features used over time.

Although not directly evidenced in the case findings, prior literature suggests that changes in use of an IS may also include individuals creating, modifying and refining work processes to more fully integrate the IS into their work practices (Majchrzak et al., 2000; Orlikowski, 2000). Thus, changes in work processes to accommodate the IS was explicitly considered as a type of variation. Consistent with prior work, the survey findings (0.165, $p \leq 0.05$) showed that changes in work processes to enable better use of the IS was a significant component of variations.

In summary, with regards to variations, the findings altogether from the case studies and survey are consistent with Sun (2012) and Orlikowski (2000), which posit that changes in use include users altering both their work processes and their feature use, as part of the process of changing how they use an IS over time.

While variations provide the raw materials, selection involves choosing some variations for eventual retention, and eliminating other variations. In the case interviews, as users related their 'journey', it was evident that not all experiments (that is, variations) were selected, but rather some were discarded. For example, in the elimination process, participants' choices were governed by selectively choosing features that leveraged the synergies offered by the fit between task(s) and IS. Subsequently, users in some instances preserved the variation (that is, retention) and thus the variation became a part of their work routine used to support their tasks.

In the survey instrument, selection and retention were operationalized and examined as a single construct rather than as distinct elements. In this regard, the focus is on 'selective-retention' (Campbell, 1960), thus incorporating the choosing of certain variants over others that is, positively selected variants. Thus overall, the model provided insights into what causes individuals to 'turn a variation into part of their story' about how they perform their work routines (Feldman & Pentland 2003). The survey findings revealed that the link between variation and retention (0.656, $p \leq 0.001$) was strongly supported suggesting that greater variety in one's use will have a positive effect on retention and thus change in one's use of an IS over time.

In essence, the findings revealed that Generalized Darwinism provided a useful meta-theoretical structure of over-arching principles that can be used to frame and explain change in IS use, by way of variation, selection and retention (Hodgson & Knudsen, 2006). Specifically, Darwinian principles as an algorithm suggested that providing variation occurs (*that is, whether by experimenting with different ways of using the System features to support one's work and/or different ways to do one's work to accommodate the System*) and there is a selection process and mechanism for preserving and retaining favourable variants, then evolution and thus change in IS use will occur (Campbell, 1960; Dennett, 1995). The findings further support the stance of Darwinists who argue that "under some minimal conditions" ongoing change in systems is inevitably Darwinian, thus involving Darwinian principles of variation, selection, retention (Aldrich, et al., 2008; Hodgson & Knudsen, 2006), thereby rendering Generalized Darwinism as a useful theory for explaining how IS use can change over time.

RQ1b. What are the key factors that influence (i.e. trigger, enable, and/or inhibit) individuals to change the way in which they use an IS?

The case findings suggested five (5) key triggers and/or enablers of variations: *peer learning*, *IS Support (Perceived Resources)*, *intrinsic motivation*, *extrinsic motivation*, and *domain-related knowledge*. Based on theoretical insights from the evolution literature, feedback valence was also hypothesized in the quantitative study as a predictor of variation, Although the case findings coupled with the theory suggested that these 6 factors are important, the survey findings showed that for the current study, only 3 of the factors were significant in predicting variations, that is, *intrinsic motivation, domain-related knowledge* and *feedback valence*.

Furthermore, the case studies suggested that *satisfaction* played a key role in users' decision to retain a variation, that is, whether or not it would be included as a part of their routine. This was likewise shown to be a significant predictor of retention in the survey findings. These findings all together, are discussed in further detail below.

Intrinsic motivation

Intrinsic motivation can be defined as the doing of an activity for inherent satisfaction rather than for some separable consequence (Ryan & Deci, 2000a) and was a particularly salient enabler in all 3 case studies. The results showed that some users (especially more advanced users) were more self-driven in their learning, seeking out new and different ways to use the system in their work and to overcome obstacles to use, which are characteristic of persons who are intrinsically motivated (Ryan & Deci, 2000a; Vallerand, 1997). For example, as a user related "*I just fiddled with it [the CRM system] until I got it to what I want it to do. At work I'm really conscientious and really a go-getter and pushy, cause I want it to work*." This finding is consistent with other studies, which found that intrinsic motivation drives individuals to engage in complex, innovative, and extra-role tasks (Ke et al., 2013; Li et al., 2013). Intrinsically motivated individuals are therefore more likely to expend energy exploring the IS (Cooper & Jayatilaka, 2006).

Furthermore, the case findings were also consistent with prior research which suggests that intrinsic motivation may be manifest in different types, such *as intrinsic motivation to know, intrinsic motivation toward accomplishment and intrinsic motivation to experience stimulation* (Vallerand, 1997, 2004; Vallerand et al., 1989; Vallerand et al., 1992).

Intrinsic motivation to know is the engagement in an activity to experience pleasure and satisfaction from learning, exploring or trying to understand something new (Vallerand, 1997). For example, one participant shared, *"I think that I'm probably one of the rare people, where I will make time to read things. I will make time to learn new systems."* Intrinsic motivation toward accomplishment is the engagement in an activity for the pleasure and satisfaction experienced when attempting task mastery, surpassing oneself, or in trying to accomplish or create something (Pelletier et al., 1995; Vallerand, 1997). For instance, a participant shared "*I suppose I'm pretty proactive, because I would be looking for something and what they have there wasn't quite fitting what I was looking for. So I just change it, or find a way to change it*." Finally, intrinsic motivation to experience stimulation refers to engagement in an activity for feelings of sensory pleasure, fun, excitement or aesthetic enjoyment associated with it (Vallerand, 1997). For instance, a participant shared that he/she engaged in variation because "*it's quite fun to do… just to see what things you can do [in the System]."*

Similar to the case findings, the survey findings showed that intrinsic motivation (0.166, $p \leq 0.05$) had a significant and positive effect on variation in the survey findings. While all three (3) forms of intrinsic motivation were evident in the case studies, being mentioned by some of the case study participants, the significance of these could not be ascertained easily from the case study evidence. The survey findings provided some insights for the particular study context. They revealed that only intrinsic motivation to know (0.306, $p \leq 0.05$) and intrinsic motivation toward accomplishment (0.261, $p \leq 0.05$) were significant in relation to overall intrinsic motivation in the context. A possible explanation for the insignificant relationship between intrinsic motivation to experience stimulation and intrinsic motivation may lie with the dominantly utilitarian nature of the focal IS (i.e. Learning Management System). Prior research argues that fun and/or enjoyment may be a more dominant predictor of hedonic (fun) IS use (Gerow et al., 2013; Van der Heijden, 2004). Given that the focal system in the survey context was utilitarian in nature, it seems then that intrinsic motivation to experience stimulation (such as fun or excitement) was unlikely to be a significant aspect of intrinsic motivation to engage in variations. Although inconclusive, this may be similar for the case studies, which likewise focused on utilitarian systems.

Extrinsic Motivation

Extrinsic motivation refers to doing an activity for some separable outcome, such as its instrumental value (Ryan & Deci, 2000a). In this study, *extrinsic motivation* was evident especially in the form of mandated use or directives from management (e.g. to use specific features of the IS), and was a deliberate tactic used in only one of the cases - AgriCo. These tactics served as external regulators of change and triggered variations. However, while extrinsic motivation can play a role in encouraging certain forms of variations such as use of formerly unused features, it is less likely to drive innovative use behaviours (Li et al., 2013).

There was also evidence of these external regulations being internalized, where persons came to recognize the instrumental value of using the system to support their work. For example, there were instances where users AgriCo users identified with the personal importance of a behavior, that is, a regulated change in use, thus accepting the regulation as their own. Altogether these findings are consistent with prior literature which suggests that there are different forms of extrinsic motivation, that differ in the extent to which they represent controlled (i.e., external, introjected regulation) versus self-determined (i.e., identified, integrated regulation) behavior (Ryan & Connell, 1989; Ryan & Deci, 2000a).

For EnergyCo and CommCo, there was no clear evidence of extrinsic motivation (e.g. in the form of management directives or performance incentives) as a factor that triggered and/or enabled variations. Similarly, for the survey findings, the results showed that the relationship between extrinsic motivation and variation was not significant. Thus, unlike AgriCo that had policies and incentives in place to encourage users, in particular the Account Managers, to change their use of the IS over time, these were not seemingly present for the other cases or for the survey context.

Turning to the types of extrinsic motivation, the survey findings found that external regulation was significant in respect to extrinsic motivation to engage in variations (0.307, $p \leq 0.05$), while introjected and integrated regulation were not significant. This may suggest that the faculty respondents did not internalize regulations regarding change in use. This stands in contrast with the findings from AgriCo, which suggests for Account Managers in particular, that over time these regulations were internalized. Altogether, the differences found regarding extrinsic motivation and its sub-dimensions are likely due to differences across the study contexts where external motivators for change were in place in one organization (AgriCo) but not evident in the other organizations including the survey context.

Domain-Related Knowledge

The case findings revealed that *domain-relevant knowledge* including knowledge of the features of the IS and work processes were also instrumental in facilitating variations. As users became more knowledgeable of the IS features and how they can be applied to work tasks, this enabled and/or triggered variations. For example, a user related "*The whole CRM can seem a little bit daunting with all its different functions and [then] you get that knowledge base- where you can say – what does that do, and why do we do that… And what's our whole reasoning behind using that particular thing [feature] is.*" Work process understanding was explicitly mentioned and particularly evident in one case (CommCo), due to the tight coupling between the work processes and the IT Service Management System. As a user noted, variation was facilitated by "*understanding that process behind it and then being able to apply real life examples- this is how a change happens in the real world and this is how it happens in [ITSM], [that is] understanding where the synergies were.*"

The findings from the survey were also consistent with that from the case studies, which revealed that domain-related knowledge (0.271, $p \leq 0.05$) had a significant and positive effect on variation. Additionally, knowledge of IS features (0.435, $p \leq 0.001$) and work process understanding (0.350, $p \leq 0.001$) also had a significant and positive effect on domain-related knowledge.

Consistent with prior research, *domain-relevant knowledge* was therefore instrumental in facilitating changes in post-adoption IS use (Deng & Chi, 2012) and is key in changing behaviour (Amabile, 1983, 1997). As users' software understanding increases, it is likely that the assimilation of its features also increases (Jones et al., 2008). Furthermore, as users better understand their work processes in the IS context, they are likely also to surface new IS features to better support these processes (Jones et al., 2008).

The case studies also found that lack of knowledge was an inhibitor to users performing variations, which is corroborated by other research such as Deng and Chi (2012). It was found however that knowledge as an inhibitor had a lesser impact on constraining use for advanced users than for basic users. This is likely because advanced users tend to be more persistent and more confident in their ability to overcome barriers to use (Ryan & Deci, 2000a).

Peer Learning

The case findings suggested that peer learning can improve individuals' use of an IS and enrich ones' skills and ability to further leverage the features of the IS. Especially for task-specific uses and improvements, the case revealed that peers were one of the key sources of ideas and encouragers of changes in use. As a user shared "*you pick up from your co-workers… [e.g.] a particular function that you are not using and they show it to you".* Some users also found learning from more experienced users to be an asset, as they *"know how to use the program to your advantage and how to get the most out of it."*

Prior research suggests that support from organizational peers is important in facilitating use (Sykes, Venkatesh, & Gosain, 2009). Social learning theory supports the notion that new patterns of behavior can be developed through direct experience or by observing the behavior of others (Bandura, 1971; Bandura & McClelland, 1971). Evidence from the case studies likewise showed that individuals learned from both observation and through the active teaching (e.g. direct teaching) of their peers, which better aided them in performing their roles. As users share their context-sensitive understanding of IS with each other, it facilitated the assimilation of new work processes (Chan, Li, & Pierce, 2012). Peer learning also enables users to develop new ways of integrating the IS in their work, and improve upon their existing knowledge of the IS features (Boudreau, 2005; Santhanam et al., 2007).

In contrast, the survey findings revealed that the relationship between peer learning and variation was not significant for the particular study context. A possible explanation was that the survey context, in contrast to the case study organisations, did not have an environment that actively encouraged peer learning or where peer learning was a norm. Had the study been conducted in an environment where there was more peer learning in place, the outcomes may have aligned more with the findings from the three (3) case studies.

Perceived Resources

Another important enabler in the case studies was having a helpful and responsive IS support team (or individual) to guide individuals' use, handle queries on how to use IS to perform work task(s) and provide tips on feature use. In organizations that had formal on-going training, this facilitated variations and helped shape and reshape individuals' use of the IS. While on-going training enabled variations, users also spoke about inadequate or irrelevant training which hindered their use and thus their engagement in variations.

These findings are supported by existing literature which purports that especially for complex information systems, which are characteristically more difficult to understand and use, the availability of different levels of IS support is pivotal (Venkatesh & Bala, 2008). IS support staff, that is, individuals who can respond well to user problems and requests, and help improve user fluency with the IS over time (Spitler, 2005) are essential for encouraging change and in advancing IS use.

The survey findings on the other hand showed that the relationship between perceived resources and variation was not significant in that context. However, training was shown to have a significant positive effect on perceived resources (0.611 $p \leq 0.001$), which is supported by the IS literature (Amoako-Gyampah & Salam, 2004; Calvert & Seddon, 2006). A possible explanation for the non-significant relationship between perceived resources and variations is that the mere existence supporting of resources (such as IS support) though important for use (Mathieson et al., 2001) may not be enough to enable and/or trigger variation as was evident also in one of the cases – CommCo. Here, although the company had an in-house System Trainer and regular training sessions available, some users did not take advantage of these resources, complaining in some cases, that the training was not sufficient or relevant to their job roles. Thus although training was in place, the evidence suggested that this had a lesser impact (or an inhibiting effect) on variations compared with other factors.

Feedback Valence

Although not directly evidenced, the case studies implied that feedback valence played a role in facilitating variations. In support, the quantitative findings revealed that feedback valence had a significant positive effect on variations (0.330, $p \leq 0.001$). This is consistent with the extant literature which suggests that feedback valence (that is, where feedback is negative or positive) (Ilgen & Davis, 2000) is an important aspect of feedback. Positive feedback is a deviation-amplifying processs which may allow variations to be generated, while negative feedback may be considered a deviation-countering process that may lead to stasis (Seaborg, 1999; Smith, 1986).

Satisfaction with Variation

The case studies suggested that users retained selected feature for continued use (i.e. retention) if they were satisfied with how they performed in achieving work tasks (e.g. improving performance, meeting work goals). Furthermore, findings from the case studies suggested that the greater one's satisfaction with the variations, the greater the likelihood that such variations will be incorporated into one's routine. Similarly, the IS literature posits that satisfaction plays a role in determining continued use of IS/IT and/or long-term usage (Bhattacherjee, 2001; Parthasarathy & Bhattacherjee, 1998). Likewise, the evolution literature suggests that a satisfactory outcome will likely result in a variant being retained for future use (Furneaux et al., 2010).

The survey findings therefore corroborated with the case findings, as satisfaction with a variation was shown to have a significant and positive effect on retention (0.159, $p \leq 0.10$). However, it was found that satisfaction as a moderator of the relationship between variation and retention was not significant, and therefore did not have an additional effect on retention over the direct impact that was observed.

RQ2. How does an individual's change in IS use lead to or impact other forms of use?

The case studies revealed that as IS use changed over time, by way of retention, it resulted in deeper levels of use, where deep use makes greater use of the features of an IS to support one's work (Schwarz, 2003). Likewise, the survey findings revealed that retention was positively associated with deep use types, namely extended use (0.454, $p \leq 0.001$), integrative use (0.208, $p \leq 0.05$), and emergent use (0.502 $p \leq 0.001$). These three (3) use behaviours are instrumental in leveraging the full potential, that is, infusing the IS into one's work practice (Saga & Zmud, 1994). This is an important finding as it suggests that managers can facilitate retention as a means to foster and encourage other forms of use. So by revising one's use of the IS, this may address the problem of underutilization (Jasperson et al., 2005; Sun, 2012).

Extended use refers to use of more of the IS features to accommodate a broader set of work tasks. Thus employees' extended use presents an opportunity for organizations to utilize their IS in a more comprehensive and sophisticated fashion (Hsieh & Wang, 2007). Integrative use allows users to establish, enhance or reinforce linkages among a set of work tasks, which is needed for an organization to achieve IS-facilitated workflows (Saga & Zmud, 1994; Ng & Kim, 2009). Emergent use occurs when one uses IT to perform new tasks that were not feasible or recognized prior to the application of the technology to the work system (Saga & Zmud, 1994). Altogether the findings showed that such behaviors allow users to capitalize on the value potential of the IS by exploring more sophisticated ways to utilize the IS (Li et al., 2013). Thus, retention through continued use of a variation, that is, by incorporating it into one's routine may allow users to better leverage the IS (through extended, emergent and integrated use) and further enable the benefits of the IS.

The results also show that only extended use (0.542, $p \leq 0.001$) and integrative use (0.233, $p \leq 0.05$) have significant effects on infusion, however the relationship between emergent use and infusion was not significant (-0.031). Although emergent use is argued to be a means through which infusion is realized (Saga & Zmud, 1994) drawing insights from the ambidexterity literature, it may also be argued that too much exploration may be counter-productive entailing an endless cycle of search and unrewarding change (Raisch & Birkinshaw, 2008), that can disrupt the embedding of various feature uses into one's work routine.

Contrary to hypothesis H12, the survey findings revealed that routinization also did not have a significant effect on infusion (-0.075). However, post-hoc analysis using bootstrap analysis and a sample size of 258, suggests that with a larger sample size, a significant though negative impact ($p \leq 0.05$) is likely to be observed. This contrary result would not be altogether unexpected, as the literature suggests that routinization can have both positive and negative effects. For example, Sundaram et al. (2000) found that routinization was positively associated with infusion, suggesting that higher infusion levels may be more likely when individuals have a stable working-level set of routines. Likewise, the creativity literature argues that routinization may be beneficial for creativity (an infusion type behavior), because it frees cognitive resources allowing employees to develop new ideas while working, and to implement them (Ohly, Sonnentag, & Pluntke, 2006). On the other hand, there is a negative aspect to routinization, as it can lead to inertia, as routines can tend to be difficult to change (Nelson & Winter, 1982). In other words, routinization can lead to standardized behavioral patterns, thus narrowing the range of post-adoptive behaviors that users will enact in familiar situations, and causing the user to focus only on a few features of the IS, as opposed to exploiting and exploring the IS for application in one's work. This suggests that too much routinization may therefore have a negative impact on infusion.

7.3 Chapter Reflection

This chapter discussed the findings presented in Chapter 4 (qualitative results) and Chapter 6 (quantitative results). All research questions (See Chapter 1) were addressed and the stated hypotheses (in Chapter 5) discussed in the light of the findings and prior research. The next chapter provides insights on the implications of the findings for theory and practice.

Chapter 8. Conclusion

"In literature and in life we ultimately pursue, not conclusions, but beginnings."
[Sam Tanenhaus]

8.1 Chapter Overview

This chapter discusses the contribution of the findings to both theory and practice, followed by the limitations of the study and suggestions for future research. Finally, the concluding remarks of the thesis are presented in the last section.

8.2 Contributions to Theory

This research examines individuals' change in IS use over time, how and why such changes occur and the outcome of such changes. It seeks to (i) investigate the process that underpins changes in IS use, (ii) determine the key factors that trigger, enable, and inhibit change in use, and (iii) examine the outcome of change. More specifically, as stated in Section 1.3, the research questions are as follows:

1. How does individuals' use of IS features change over time?
    a) What behaviours (or actions) underpin individuals' change in IS use?
    b) What are the key factors that influence (i.e. trigger, enable, or inhibit) individuals to change the way in which they use an IS?
2. How does an individual's change in IS use lead to or impact other forms of use?

This research makes a number of conceptual and theoretical contributions to the IS literature. First, there is a short supply of research on post-adoption IS use, particularly on how individuals (choose to or are influenced to) learn about, selectively adopt and apply, and then extend IS use (Jasperson et al., 2005). While prior models such as Technology Acceptance Model and Task Technology Fit provide insights on the use of an IS, they do not explain how and why users revise their use of an IS as they enact work tasks (Beaudry and Pinsonneault, 2005).

Second, while there are a few studies on change in IS use (Al-Natour & Benbasat, 2009), these are limited in their focus and ability to explain change at the individual level and its outcomes (Fadel 2012; Sun, 2012). For example, Sun (2012) offers a theoretical framework of the types of changes that occur and the triggers of change to explain how and why persons revise their system use, but does not discuss how change unfolds. Orlikowski (2000) also examines how changes in use have been enacted, but does not seek to predict change or examine the outcomes of such change. This research bridges a gap in the literature by investigating further the process of change and seeking to identify the conditions under which change can occur and the outcome of such change. This study therefore contributes to the literature by putting forward a predictive model of change, thus going a step further than prior research (Orlikowski, 2000; Sun, 2012) in providing an understanding of the process of change, and how this impacts outcomes, in this case, deeper use.

Another key theoretical contribution of this research is that it puts forward a new lens, that is, Generalized Darwinism, for examining change in IS use over time. Darwinian evolution has become a cornerstone theory of biology and over the last few decades, scholars such as physiologists, anthropologists and economists have recognized the value of using an evolutionary theory to guide their work (Goetz & Shackelford, 2006). Darwin's theory of evolution has been used to describe many organizational changes, which supports its validity (Burke, 2010; Kezar, 2001). Using an evolutionary lens therefore does not require the need to invoke biological adaptation to explain a particular phenomenon, nor does it require that we identify an analogy for the specific mechanism of variation, selection and retention as in biological evolution (Aldrich et al., 2008). Instead, Darwin's theory of evolution, in its most abstract form, describes mechanisms that introduce variation, and has a selection process that preserves and/or retains the selected variants (Campbell, 1974; Hodgson, 2002, 2005). Thus, at a general level of abstraction, the core set of Darwinian principles can be used to describe evolution within a variety of non-biological domains (Hodgson & Knudsen, 2006b), and in this case, change in how an IS is used over time.

All theories of evolution are concerned with change over time, and the basic theory of biological evolution is the notion that species change (Stoelhorst, 2008b). In using the evolution metaphor, a key question that should be answered is 'what actually evolves' (Devezas, 2005). Routines have been traditionally used as a 'central unit of analysis' (Becker, 2004, p. 643) in evolutionary economics. There is no doubt that the concept of routines is widely accepted as a collective rather than an individual-level phenomenon (Nelson & Winter, 1982). However there have been calls for a focus on a micro-foundation view of routines, that is, understanding the micro entities that make up the 'collective' (Felin et al., 2012). Thus, it is suggested that rather than examine routines at a macro-level or collective phenomenon only, the explanatory mechanisms should include individuals' actions, interactions, endowments, intentions, desires, expectations, goals and motivation (Abell et al., 2008; Felin & Foss, 2004).

This research therefore applies an evolutionary lens at the micro-level, focusing on the actual enactment of the routine (performative routine), that is, individuals' use of an IS in carrying out organizational routines. Thus, theoretically, this research responds to calls for (i) alternative theoretical perspectives to better understand variation within and across individuals' post-adoptive behaviour (Jasperson et al., 2005), and (ii) a micro-foundation view of routines, that is, understanding the micro entities that make up the ‘collective’, which includes individuals in the organization (Felin et al., 2012).

In this research, *variation* is defined as experiments with (i) different ways of using the System features to support one’s work and/or (ii) different ways to do one’s work to accommodate the System. There is a paucity of research that has systematically developed and empirically tested changes in post-adoption use at the feature level (Sun, 2012) or work-process level (Orlikowski, 2000). The concept of variation alludes to experimentation, which has a rich history in the fields of problem-solving and learning, representing the iterative nature by which users interact with an IS (Desouza et al., 2007). By extension, the second concept introduced is *retention*, where a selected variant becomes a part of the user’s routine. Retention is important, as although changes or adjustments may occur within an individual’s use of the IS, if these changes are not selected and embedded within one’s routine, the way in which the IS is used will remain in equilibrium (Jasperson et al., 2005).

Although an evolutionary perspective of variation, selection and retention is useful for understanding IS-related phenomenon, to date, it has not been used to empirically examine change in IS use. Likewise, other studies (Abraham et al., 2013) have also recognized the value of using theories from biology to examine use. Abraham et al. (2013) used the ‘four drive model’ to describe human nature based on evolutionary force, that is, the drive to acquire, the drive to bond, the drive to defend, and the drive to learn. Drawing on these drives and findings from a qualitative study, Abraham et al. (2013) discussed the role that each of these four factors played in nurses' decisions to accept and adopt Mobile Information Communication Technologies. Thus, a key contribution of this study is to show how concepts drawn from evolutionary biology and theory can be used to explain human action in this case regarding change in IS use.

The work presented in this research is therefore an initial attempt to develop a change model of IS use, grounded in explaining change at the individual level. Part of this effort included the conceptualization and operationalization of constructs that capture variation and retention. There were no prior studies found that have systematically developed and empirically tested measures for variation and retention within or outside the IS literature. Therefore, beyond a theoretical contribution on change in IS use, this study also offers a set of adaptable measures for assessing the concepts of variation and retention, which can be used to operationalize the constructs in future models aimed at assessing and predicting change.

Besides understanding how IS use changes over time, it is also important to understand what influences the changes (Sun, 2012). From a theoretical perspective, it was anticipated that this research would add to the IS literature on post-adoption use by providing insights into triggers, enablers, and inhibitors that impact change. Theories such as Technology Acceptance Model and Theory of Reasoned Action although integral in explaining intention or regular use, are lacking in explaining actual technology use (Jones et al., 2002), and thus caution should be taken in applying such to deep-use types such as infusion (Grgecic & Rosenkranz, 2010; Hsieh & Wang, 2007). By taking an inductive approach to identify key factors, this research responded to calls for further work on factors that are more suited to the post-adoption context, and which enable revisions in post-adoptive behaviors and further movement towards deeper use (Chin & Marcolin, 2001; Hsieh & Wang, 2007). The results of the combined qualitative and quantitative study showed that users, albeit at different rates, do change their use of the IS over time through mechanisms of variation, selection and retention. The findings further revealed that variations were triggered and/or enabled by intrinsic motivation, extrinsic motivation, peer learning, domain-related knowledge, perceived resources, and feedback valence. Also, lack of knowledge and training issues were noted as inhibitors to variations. Satisfaction in turn played a key role in preserving variations selected through retention decisions.

Lastly, while not all changes will lead to deeper use of the IS, it is expected that in a rational context changes in IS use would ultimately be aimed at developing more deeply ingrained use behaviour (Agarwal, 2000; Chin & Lee, 2000). However, there are only a few studies that have hypothesized and empirically investigated how one form of use impacts or leads to other forms of use (Chin, Mills, et al., 2012). This research therefore also examined the impact of retention on other forms of use, that is, deeper forms of use. The results showed that retention had a positive and significant effect on extended, integrative and emergent use, which in turn may have a positive impact of infusion (Saga & Zmud, 1994). Thus, the findings contribute to the literature by adding further insights on the relationships between different forms of use (Saga & Zmud, 1994), in particular how one use-type leads to and enables other use-types (Chin & Marcolin, 2001) in this case, deeper use of the IS, that is, infusion.

In summary, Generalized Darwinism as a meta-theory, was used in this study to describe and frame how and why individuals' use of IS may change over time. The findings suggest that Generalized Darwinism is a useful and alternate lens for understanding post-adoption IS use, providing further insights and contributions also to the body of literature on change.

8.3 Contributions to Practice

Understanding how individuals revise their use has practical implications. First, this study offers a guide for managers and/or practitioners to recognize how individuals can alter their IS use (Sun, 2012), whether by purposeful or emergent actions. In response, managers can implement interventions that induce variations, such as applying unused features, to foster revisions in use that lead to deeper engagement with the IS. Otherwise, failure to enable change can result in users engaging in recurring patterns of using a selected subset of technology features in their work, which may result in underutilization of the IS (Jasperson et al., 2005).

It has therefore been advocated in the academic literature and trade press that managers should develop and implement effective interventions in order to maximize employees' use of an IS (Venkatesh & Bala, 2008). To allow for greater and more effective use of IS, it is important for IT practitioners to better understand the enablers, drivers/triggers and inhibitors (Burton-Jones & Grange, 2013; Cenfetelli & Schwarz, 2011; Hsieh & Wang, 2007) that impact change in IS use. Without such knowledge, the post-adoption stage proceeds on limited information, and organizations can less proactively manage the process (Griffith, 1999). By identifying factors, and by extension, interventions that could influence use of the IS, this may aid managerial decision-making towards more successfully managing the post-adoption cycle (Jasperson et al., 2005). This section discusses the findings on factors that influenced change in use, and recommends intervention strategies that may help foster and direct appropriate changes in use.

The findings from the qualitative and quantitative studies suggest that whether or not the overall setting is one that mandates IS use, intrinsic motivation may be key to encouraging persons to use their initiative to engage in actions geared at creating variations. This is important especially since performing variations is most often a voluntary behaviour. Managers may therefore play an important role in influencing those factors that have been shown to stimulate intrinsic motivation, for example, by helping users to feel competent and more self-determined (or autonomous in their actions) (Ryan & Deci, 2000a). For instance, ensuring that training aimed at supporting contextual needs can help improve the user's sense of competence, which may in turn foster increases in intrinsic motivation.

The findings also provide insights into more specific aspects of intrinsic motivation (IM) that managers can focus on. For example, managers can nurture users' intrinsic motivation by taking actions to encourage IM to know, IM towards accomplishment and IM to experience stimulation. For example to encourage IM to know, managers could take steps to foster a learning environment in which users are able to learn as they share knowledge with each other and satisfy their curiosity (Li et al., 2013). For instance, in one of the cases, AgriCo, there was a 'buddy' system implemented by managers, which allowed users to learn from each other how to better use the CRM. In the case of IM toward accomplishment, managers can provide the necessary resources, for example through IS or peer support to assist users when they face difficulties in using IS (Li et al., 2013). For example, at CommCo, there was an in-house trainer with advanced knowledge of the ITSM system who was available for any queries or assistance in using the system. At AgriCo, peers were an invaluable source of advice and help with using the IS. Another recommendation is that managers can assist users in setting up meaningful performance objectives that could be accomplished through their use of the IS (Li et al., 2013). For example, at AgriCo, team leaders met each Customer Service Representative (CSR) every month to discuss their performance and ways in which the IS can be used to enhance the way they work. Finally, to foster IM to experience stimulation, managers can offer IS that have hedonic characteristics which may help to improve employee moods, increase user satisfaction, and encourage involvement through experimentation (Gerow et al., 2013).

Extrinsic motivation, in the form of mandated use or directives from management (e.g. to use specific features of the IS) also played a role in the case studies in performing variations. These served as external regulators of change and triggered change in use. Extrinsic motivation in the form of directives was strongly evident in one firm - AgriCo. In particular, at AgriCo, the CRM was used "*as a monitoring tool of how the Account Managers perform"*, and use was tied to performance. As managers aligned the use of certain features to performance, individuals came to use previously unused features to meet the requirements. However, prior research suggests that directives may not always be a significant predictor in certain contexts (Sun, 2012), which was the case in the survey context, where use was largely voluntary. However, the case findings do suggest that these regulations can impact change; furthermore these can have an even greater impact on change when management communicates the benefits and/or instrumental value of using various aspects of the IS to users. This in turn can enable individuals to identify with the importance of the behavior (identified regulation), hence making it a more autonomous or self-determined form of extrinsic motivation (Ryan & Deci, 2000a). Indeed, it is suggested that extrinsically motivated individuals are more likely to engage in pro-active use behaviors, when control is minimized and there is a sense of volition (Deci, Koestner, & Ryan, 1999; Ryan & Deci, 2000a). Hence, it may be advisable for management to strive for 'balance' and foster less of a 'dictator-styled' environment when mandating use and changes in use.

Thus, in considering both intrinsic and extrinsic motivation, the work environment can indeed 'exert a powerful impact' on changes in behaviour by influencing motivation (Ayala, 2007). As such, it is imperative for organizational leaders to understand and deal more effectively with motivations (Amabile, 1993), both intrinsic and extrinsic.

Domain-related knowledge also played a role in creating variation in both the case studies and survey findings. The case findings further showed that lack of knowledge was an inhibitor underlining the importance of adequate knowledge for fostering variation. Thus, it is paramount that managers implement strategies to bridge the gap between what users know and what they need to know, to help enable a better user experience (Ceaparu, Lazar, Bessiere, Robinson, & Shneiderman, 2004). Such intervention strategies can include creating shared knowledge resources such as short videos on particular features or designating user representatives (e.g. power users) to assist the IS team with addressing frequently experienced problems (Deng & Chi, 2012) or underutilized aspects of the IS. Also, managers can implement targeted formal training on how work processes differ with the IS implementation and how various processes relate to other key work processes (Jones et al., 2008). Altogether, such interventions focusing on enhancing users' knowledge of work processes as well as knowledge of the IS can in turn help to enable and drive user exploration and exploitation of IS features (Jones et al., 2008).

Peer learning, though not a significant predictor of variations in context of the survey, was instrumental in the case findings. Managers can promote peer learning by designing or directing informal training sessions among peers (Jasperson et al., 2005), or by providing forums for peers to share tips and demonstrate discoveries or use of particular system features. Fostering peer learning was a key strategy used by the case organizations. For example, at AgriCo where formal IS support was limited, management proactively encouraged users to demonstrate and discuss how they use particular features. In another example, at CommCo, there was a voluntary forum where users could share their knowledge on various aspects of the IS and engage in questions and answers about how to use particular features.

Feedback valence (whether positive or negative) was found to have a significant and positive effect on variation. While managers cannot control the valence of all the feedback that users receive, they can enable an environment where users can receive feedback on their interaction with the IS. For example, at CommCo, they had a 'test' system, which users could experiment with the features of the ITSM. A test system can allow trials without fear of failure. Having systems that allow for 'roll-backs' may also encourage trials. Positive feedback from the system can then encourage experimentation and eventual retention of feature combinations that work well. Feedback can also come from others, such as peers, co-workers and supervisors (Ilgen, Fisher, & Taylor, 1979). Indeed, studies have found that peer feedback may have a greater effect on developmental activities, and is more powerful for subsequent behavioral change than supervisor feedback (Maurer, Mitchell, & Barbeite, 2002; Van den Bossche et al., 2010). Thus settings in which users can share discoveries and received feedback from peers may be useful and would also help to further support peer learning.

Perceived resources was also another factor that played a positive role in the case studies, but was not a significant predictor in the context of the survey findings. Despite the seemingly contrary findings, it is important for managers to maintain appropriate resources (e.g. IS support and training) in the post-adoption stage that will enable variation. Prior research suggests that resources aid in the users' learning process as they interact with the IS over time, and serve to also develop capacity to further leverage the IS (Kang & Santhanam, 2003). It is therefore recommended that managers coordinate on-going training interventions to meet users' evolving needs as they interact with the IS. Such training interventions can be formal or informal, scheduled or just-in-time, and/or human- or technology-enabled (Jasperson et al., 2005), depending on the users' needs and learning styles. Also, based on insights from the case studies, for training to be more effective it should be specific to job roles, providing information on how the IS can be used to perform work tasks. Indeed, the case findings showed that lack of training was an inhibitor of variations further underscoring the importance of on-going training for fostering variation.

With regards to retention, satisfaction played a key role in determining the users' decision on whether to incorporate a variation into their work routine. Managers can help support these evaluative processes that lead to satisfaction (Oliver, 1997) by communicating the value and/or potential benefits of aspects of IS (Bhattacherjee, 2001; Parthasarathy & Bhattacherjee, 1998). For example, when users know the benefits, they can better evaluate whether a change satisfies a goal. Thus, a clear understanding of benefits and goals may help in the evaluation of a variant to determine whether it satisfies the goals and should be retained through continued use of the variation in one's work.

Finally, the findings suggest that retention may be a conduit for deeper use of the IS. By way of retention, users are likely to come to apply more of the IS features to accomplish work tasks (extended use), enhance or reinforce linkages among tasks (integrative use) and/or apply the IS to tasks that were not feasible before the implementation of the IS (emergent use). However, while the survey findings suggested that routinization did not have a significant effect on infusion, post-hoc analysis indicates that with a larger sample, the results may show a significant but negative relationship. Although this would be contrary to the positive link hypothesized in this study, prior work has shown that the effect of routinization can be positive or negative (Ohly et al., 2006). For example, in order to maximize the potential of an IS (e.g. through infusion), it may be necessary for the user to incorporate it within their work pattern (routinization) (Sundaram et al., 2000). However, if one's behavior becomes too routinized, then reflective cognitive processing can dissipate over time (Jasperson et al., 2005), which may hamper the exploration activities that may in turn increase infusion. These findings suggest there may be a curvilinear relationship between routinization and infusion, which could be investigated in future research. Future work can also investigate the conditions under which routinization might negatively or positively impact infusion. For example, the nature of the job (or work task) and the level of autonomy regarding how the IS can be used to accomplish work tasks may play in determining the effects of routinization (Ohly et al., 2006).

8.4 Limitations and Future Research

This study makes a number of contributions to research and practice. At the same time there are some limitations; these in turn provide opportunities for future research.

A notable limitation is that the data was collected at a single point in time, rather than through longitudinal study. Although, it would have been ideal to examine changes in post-adoption use over time in a longitudinal study, this was not feasible due to the time constraints for PhD research. However, to address this issue within this study, it should be noted that in both the interviews and the survey, individuals were asked to 'think back' on how their use had changed over time in an attempt to capture change retrospectively. Capturing data from different user types (i.e. from basic to advanced users) also allowed for varying perspectives at different stages of the 'journey' regarding use. Collectively these enabled reflection on key aspects of change over time even though these were not captured directly through longitudinal study.

Because the present study relied on retrospective accounts of change in use, it is subjected to errors of recall and memory biases. Prior research suggests that retrospective biases may occur because individuals have limited, imperfect recall, are influenced by their implicit or espoused theories of the past, and are subject to cognitive processes such as rationalization, self-presentation, simplification, attribution, or simple lapses of memory (DeRue & Wellman, 2009). The impact of memory and recall bias was minimized to the extent possible in this research, as all participants were directly involved in their respective experiences of change in use. Also, for the interviews, participants were asked to relate incidents or events that describe changes from their initial use to their current use, and hence scant details, poor recollection or contradictions in the stories could indicate biases and problems of poor recall. However, future research using a longitudinal approach for exploring the change in IS use is recommended where data is collected from users at two (2) or more intervals over a period of two (2) years or more. This time frame is recommended as research suggests that a two

(2)-year implementation span is most appropriate for studying deep use types such as extended use (Hsieh & Wang, 2007).

Another limitation was the relatively small (n=86) sample size for the quantitative study. In addition, most of the respondents were intermediate and advanced users (81%). Although the number of responses was sufficient for PLS analysis (Chin, 2010), a larger and more varied sample size may have yielded additional insights. For example, a post-hoc exploratory analysis using bootstrapping and a sample size of 258 (i.e. three times the original sample size) suggests that with a larger sample, the relationship between routinization and infusion, which was not significant may be significant though negative ($p \leq 0.05$). Furthermore, access to a more varied sample with the ability to segment the sample by user types (e.g. basic vs. advanced users) as with the case studies may have enabled us to examine the relationships in the model in more detail, potentially providing insights into how the various factors may differ across user types. This too is a potential avenue for future research. The findings would be particularly instrumental for management in creating intervention strategies that are tailored to specific user types, as opposed to assuming that 'one size fits all'.

Furthermore, given the relatively low response rate, the results may be influenced by non-response bias, especially for the survey, where basic users were under-represented. Interviews with the IS Support for the survey setting revealed that most academics tend to be basic users, suggesting that indeed basic users were under-represented in the current sample. Even though the best efforts were made to maximize the participation from basic users, there were difficulties in encouraging them to participate. Basic users often opted out at first from participating believing that they have not really changed their use of the IS and so have 'nothing to contribute'. This was especially evident in case studies, with basic users at the beginning of the interview consistently stating that they have not changed their use. However, as the interview progressed, the findings suggested otherwise often resulting in the interviewee realizing how much they had in fact changed their use over time. Overcoming the challenge therefore of getting basic users to participate in a survey will be key in future research.

The timing of data collection also presented a challenge for getting respondents. In particular, the survey was administered during a time period that eventually overlapped with a busy time for the respondents. As such, many of the non-respondents indicated that although they were interested they did not have the time to participate in the survey. Despite this outcome, the response rate (34%) was considered reasonable for the context. However, future research that can improve on the response rate is recommended.

Additionally, although the case studies investigated varying systems (CRM, Collaboration System and an IT Service Management System), the survey study was confined to one type of IS – a Learning Management System. Thus the findings from the survey may reflect conditions that are unique to the context, which may differ had the survey been conducted elsewhere. This is evident when one compares the findings across the cases and the survey, where the findings were found to differ for the four contexts (that is, 3 case settings and 1 survey setting). Therefore future research could examine the model in other system and workplace settings. This can further help to validate the findings.

Also, the research model showed that the predictors accounted for 0.333, 0.507 and 0.429 of the variance explained for variation, retention and infusion respectively. Altogether these findings suggest that while the current models offer moderate to high explanatory power for the outcome variables, there is opportunity for future research to improve on these models by considering factors that were not included in the current models. For example, prior research suggests that novel situations and discrepancies may also impact variations and retention (Sun, 2012). Also, future research can investigate how different facilitating conditions, such as time, monetary resources, and technology compatibility issues may influence revisions in use (Sun, 2012). Similarly prior research on infusion suggests that factors such as inertia (Polites & Karahanna, 2012), personal factors such as cognitive style and computer self-efficacy (Sun, 2012), and contextual factors such as technologies and tasks (Hsieh, Rai, & Xu, 2011) may also impact infusion.

Furthermore, due to sample size limitations control variables such as gender and age were not included in the current model. Prior research however suggests that gender may play a role in technology usage (Ahuja & Thatcher, 2005; Venkatesh & Morris, 2000). For example, it is purported that men's desire to acquire IT skills may challenge them (more so than women) to explore and learn about a technology and in turn, the process of exploration may lead them to trying to find different ways of using it (Ahuja & Thatcher, 2005). Furthermore, prior research suggests that there are age differences in technology usage (Morris & Venkatesh, 2000), such that younger persons may be more amenable to exploratory behaviours and actions (Brown & Venkatesh, 2005). Thus, gender and age can also be considered in future work.

In addition, given the likelihood of contrary findings regarding the impact of routinization on infusion suggesting (with a larger sample size) that the link between routinization and infusion is likely to be negative, further work is also advised to clarify this relationship and its implications for future research and practice.

Finally, another promising research area for future research lies with the impact of deep use (that is, infusion) on the individual's job performance. This link between infusion and performance though implied in the focus on infusion (i.e. the extent to which the user fully utilizes the system to enhance his/her productivity potential to support work (Jones et al., 2002)) was not directly investigated. It is therefore suggested that future work assess directly the link between IS use and performance (Devaraj & Kohli, 2003; Sundaram et al., 2007).

8.5 Chapter Reflection

In summary, there have been calls for research on variations in individual post-adoptive behaviours (Jasperson et al., 2005). Using Generalized Darwinism as a meta-theory (via variation, selection and retention) and supported by prior research on IS use, this study sought to understand how IS use changes over time. The research used a multi-method approach to examine change in use. Phase 1 was exploratory in nature and applied a qualitative mode of enquiry, while Phase 2 was confirmatory and used a quantitative mode of enquiry. Thus the findings from Phase 1 (case study interviews) coupled with key concepts of variation, selection and retention from Generalised Darwinism and auxiliary theories were used to create a conceptual model, which was then tested using survey data collected in Phase 2.

The study showed that variations occurred as individuals used formerly unused (available) features, modified use of currently used sets of features, substituted or replaced one (already-used) feature with another feature, and found novel or innovative uses of IS features. There were also a number of similarities in the findings from the case study and the survey regarding the triggers and enablers of variations, the impact of variations on retention, and in turn, the impact of retention on deeper use via emergent use, integrative use and extended use. Both the case studies and the survey confirmed the importance of feedback valence, intrinsic motivation, and domain-related knowledge, along with key sub-dimensions such as intrinsic motivation to learn, knowledge of IS features and work process understanding as triggers of variations. Satisfaction, in addition to variations was also instrumental in determining which variants in use were selected and incorporated (i.e. retention) into one's work routine. Furthermore, the results suggest that as changes occurred over time, such changes resulted in more deeply ingrained use behaviours, by way of infusion. At the same time, some differences were observed among the case studies, and between the case study outcomes and the survey findings, with some of the factors identified as important in the case findings, such as peer learning, extrinsic motivation, and perceived (IS) resources, not being significant as predictors of variations in the survey context, suggesting that context may make a difference in the study findings (Hong, Chan, Thong, Chasalow, & Dhillon, 2013), and that 'one size does not fit all.'

Nevertheless, the overall findings on changes in IS use and factors involved provided insights into how change occurs via variation, selection and retention and the factors (such as intrinsic motivation and domain-related knowledge) that played a key role in enabling change in use and the outcome of the change (i.e. deeper use). It is therefore anticipated that the findings of this research will contribute useful insights to the post-adoption IS literature and for managers as they tackle the problem of IS underutilization.

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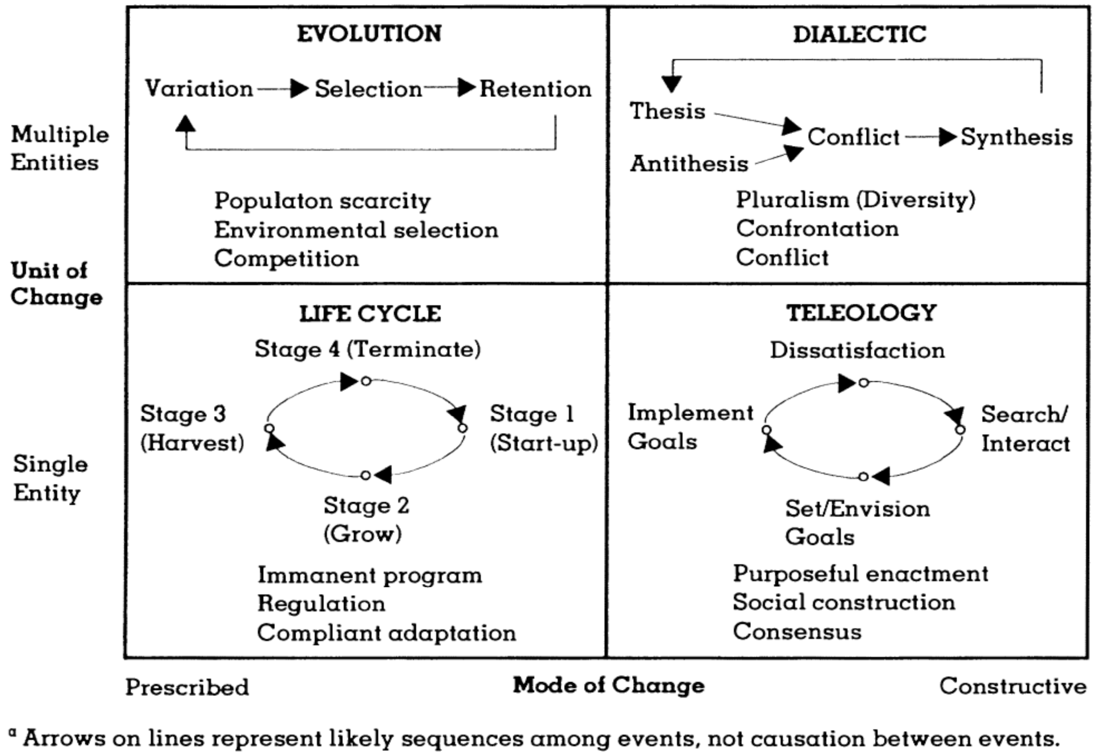
Appendix A. Alternate theories of Change

Van de Ven and Poole (1995) argued that there are at least four perspectives that can be used to analyse change processes: lifecycle, teleological, dialectical, and evolutionary. While it is not possible to examine and validate each of these theoretical perspectives throughout the dissertation per se, this appendix outlines the other three (3) theories (lens) of change that were not applied in this dissertation, that is, lifecycle, teleological and dialectical.

Figure A-1. Theories of Change



Source: (Van de Ven & Poole, 1995)

Life Cycle

In life-cycle theory "the developing entity has within it an underlying form, logic, program, or code that regulates the process of change and moves the entity from a given point of departure toward a subsequent end that is prefigured in the present state" (Van de Ven & Poole, 1995, p. 515). The metaphor of organic growth (e.g. living creature or plant) has been commonly used to explain the life cycle mode of change, which captures the crux of development in an organizational entity from its start to end. The generative mechanisms in life cycle theories have an event sequence of start-up, grow, harvest, termination and then start-up (Van de Ven & Poole, 1995). There are some defining characteristics associated with the progression of change events in a life cycle, that is, change is a predictable, unitary cumulative, and conjunctive sequence of events (Van de Ven, 1992; Van de Ven & Poole, 1995). Unitary progression suggests that the sequence of events follow in a linear, set and specified fashion, for example, A →B→C, whereby each stage may have sub-activities. It is cumulative as the characteristics from the early stages of the process are maintained and/or reflected in later stages. Each stage contributes to the succeeding stage resulting in the ultimate final outcome. Lastly, it is conjunctive as the stages are not independent of each other but share an underlying process.

The mechanisms in life cycle can be seen in organizations (e.g. they grow, mature, then stages of revival until they ultimately die), products, individual development (birth, adolescent growth, maturity, death)(Van de Ven & Poole, 1995). It can be seen as 'endogenous', and there are no 'external cues' that facilitate movement from one stage to the other (Berlyne, 1966). Change is inevitable, hence the cycle assumes that change does not occur because individuals see the necessity or even want to change; but instead occurs because it is a natural progression that 'cannot be stopped' (Berlyne, 1978). It should be noted that the external environment does have some influence, but is constrained by the inherent logics and rules that govern the sequence of events(Garud & Van de Ven, 2002). Critics of this motor of change contend that it assumes a smooth process at stages move from one to the next (Berlyne, 1966), and lacks an explanation of how and why the entity changes or remain stable as time progresses(Berlyne, 1954).

Examples of theories that demonstrate a life-cycle mode of change (Berlyne, 1950, 1960; Van de Ven & Poole, 1995) include Rogers' five stages of innovation (Rogers, 1983): (i) *need recognition, (ii) research on problem, (iii) development of idea into useful form, (iv) commercialization, and (v) diffusion and adoption*), D'Aunno and Zuckerman's four development stages in inter-firm collaborations: *(i) emergence, (ii) transition, (iii) maturity and (iv) critical crossroads*)(Bowler, 1989) and Grenier's (1972) model of organizational development: *(i) creativity, (ii) direction, (iii) delegation, and (iv) collaboration*)(Breslin, 2010).

Teleological

The philosophical doctrine governing the teleological mode of change assumes that the entity "constructs an envisioned end state, takes action to reach it, and monitors the progress" (Van de Ven & Poole 1995, p. 516). Teleological theories of this nature are purpose-oriented and relate to the pursuit of goals, and assume that the entity is adaptive. In a teleological model, the underlying assumption is that development occurs based on a cycle of goal formulation, implementation, evaluation, and modification of goals based on what was learned by the entity (Van de Ven & Poole, 1995). This sequence is a result of the "purposeful social construction among individuals within the entity" (Van de Ven & Poole, 1995). Teleological doctrine assumes that the entity (individual or group) has the independence to enact desired goal, which encourages creativity (Van de Ven & Poole, 1995). Unlike life cycle mode of change, teleological theories do not operate in accordance to a specified and prescribed order (no pre-configured rules), but rather the focus is on moving the entity towards its end state (Van de Ven & Poole, 1995). This points to another characteristic of some teleological models, that is, equifinality, that is, an entity can follow a number of trajectories (which are all effective) to achieve a goal(Van de Ven & Poole, 1995). With the focus on a purpose or goal, the theory suggests that, "everything that leads closer to the goal is perceived as development" (Berlyne, Craw, Salapatek, & Lewis, 1963). Although teleological theories assumes that the actor is purposeful, which serves as the motor of change, there are limits on the actor's action (whether internal or external) (Van de Ven & Poole, 1995).

Examples of organizational theories (Van de Ven & Poole, 1995) that are teleological in nature include adaptive learning (March & Olsen, 1976) and strategic planning and goal setting (Chakravarthy & Lorange, 1991).

Dialectical

The philosophical doctrine governing dialectical theories is conflict and confrontation between opposing entities, and the premise is that there is "a pluralistic world of colliding events, forces, or contradictory values that compete with each other, for domination or control" (Van de Ven and Poole 1995, p. 517). In a dialectic framework, change occurs as a result of the interplay between two or more opposing entities (thesis and antithesis), which forms the conflict; followed by a resolution that produces a new form (synthesis) (Van de Ven & Poole, 1995). The synthesis is typically novel, and takes on a new form that deviates from both the thesis and antithesis. Due to its cyclic nature, the synthesis becomes the new thesis, and the process continues. The dialectical process does not necessarily produce a 'creative synthesis', as power may play in a role in the outcome, thus creating not necessarily the best solution (Van de Ven & Poole, 1995).

Appendix B. Information Sheet for Chief Information Officer (Qualitative Phase)

Department of Accounting and Information Systems

Information Sheet for Chief Information Officer

We are conducting a research project on the use of Information Systems (IS) in organizations. The aim of the study is to understand when and how an individual's use of IS changes over time.

Your involvement in this project will be to facilitate two (2) interview sessions with us for approximately one (1) hour each. The aim of the two sessions is (i) to understand the implementation of the IS your organization and its use, and (ii) to recommend users in the organization that reflect different use patterns (for example, basic, creative/advanced use). These individuals will also be asked to participate in an interview session with us.

You have the right to (i) Withdraw your participation at any time up until the interview data is processed and added to the other interview data already collected. (ii) Refuse to answer any particular question, and (iii) Ask for any further information about the study.

The results of the project may be published, but you may be assured of the complete confidentiality of data gathered in this investigation: the identity of participants will not be made public without their consent. To ensure anonymity and confidentiality, I will ensure that recordings are kept securely and names of individuals and organisations are not published without prior consent. Those with access to data collected will be Vanesa Tennant, Dr. Annette Mills and Professor Wynne Chin.

Vanesa Tennant is carrying out the project as a requirement for the Doctor of Philosophy in Accounting and Information Systems under the supervision of Dr. Annette Mills and Professor Wynne Chin. They will be pleased to discuss any concerns you may have about participation in the project.

The project has been reviewed and approved by the Department of Accounting and Information Systems and the University of Canterbury and Human Ethics Committee Low Risk Approval process.

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Appendix C. Information Sheet for Interviewees (Qualitative Phase)

Department of Accounting and Information Systems

Information Sheet for Participants - Users

We are conducting a research project on the use of Information Systems (IS) in organizations. The aim of the study is to understand when and how an individual's use of IS changes over time.

Your involvement in this project will be to facilitate an interview with us for approximately one (1) hour. The intent is to understand your use of the IS in your job.

You have the right to (i) Withdraw your participation at any time up until the interview data is processed and added to the other interview data already collected. (ii) Refuse to answer any particular question, and (iii) Ask for any further information about the study.

The results of the project may be published, but you may be assured of the complete confidentiality of data gathered in this investigation: the identity of participants will not be made public without their consent. To ensure anonymity and confidentiality, I will ensure that recordings are kept securely and names of individuals and organisations are not published without prior consent. Those with access to data collected will be Vanesa Tennant, Dr. Annette Mills and Professor Wynne Chin.

Vanesa Tennant is carrying out the project as a requirement for the Doctor of Philosophy in Accounting and Information Systems under the supervision of Dr. Annette Mills and Professor Wynne Chin. They will be pleased to discuss any concerns you may have about participation in the project.

The project has been reviewed and approved by the Department of Accounting and Information Systems and the University of Canterbury and Human Ethics Committee Low Risk Approval process.

Researcher' contact details	Supervisor's contact details	Supervisor's contact details
Vanesa Tennant	Dr. Annette Mills	Professor Wynne Chin
University of Canterbury	University of Canterbury	University of Houston
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Appendix D. Consent Form (Qualitative Phase)

Department of Accounting and Information Systems

Consent Form for Participants

Vanesa Tennant
Department of Accounting and Information Systems
University of Canterbury
Private Bag 4800
Christchurch 8140

Investigating Information Systems Use

I have read and understood the description of the above-named project. On this basis I agree to participate as a subject in the project, and I consent to publication of the results of the project with the understanding that anonymity will be preserved.

I understand that the interview will be audio-recorded in order to accurately capture my views. I understand that I may withdraw my participation from the project, including withdrawal of any information I have provided, at any time up until the interview data is processed and added to the other interview data that has been collected.

I understand that the data collected in the interview will be stored both physically (transcripts and notes) and electronically. I also understand that the data will be kept for 10 years and will be stored securely. After 10 years, the data will be destroyed.

I understand also that the results may be published beyond the thesis, and that the PhD thesis will be a publically available document via the University of Canterbury library database.

I note that the project has been reviewed and approved by the Department of Accounting and Information Systems and the UC Human Ethics Committee Low Risk Approval process.

NAME (please print): ……………………………………………

Signature: ……………………………………………

Date: ……………………………………………

Appendix E. Interview Schedule

Preamble and Statement of Purpose of the Study:

My name is Vanesa Tennant and I am a doctoral student studying information systems at the University of Canterbury. I am here to understand how your use of the [system name] has changed over time.

1. Can you tell me about your job and what you do?

2. Using a time line, I would like you to discuss your use of the system from when you started to now

    - Further probes:
        i. What brought about/led to this change/How did this come about?
        ii. What was the impact of the change on your tasks?

    - For examples of specific changes in use of [system name], further probe:
        - How did it happen?
        - What conditions were there in place to facilitate this change?
        - What happened as a result of this change?

3. Are there more things that you would like you do with the system (Examples)?
    - What conditions would be necessary for you act on these (or ‘to do these things’)

Conclusion and End of Interview

Is there anything else you would like to discuss about [system name] and how it is used?

Appendix F. Coding Sample

Text Segment	Code/Classification	Description
"I've started using the segment in the CRM…you can [use it to] look up certain customers with certain criteria by using the segments and combining segments to bring out lists of people that you need to see…"	Trying New Features	This code refers to the act of using a new feature (that is, a formerly unused feature) to perform a work tasks.
"I've gotten better at narrowing down criteria and understanding which particular fields will give me the results that I am actually looking for… so that I [am] actually getting returns for criteria that I'm actually interested in, and organizing it in such a way that it makes sense. [for example]… the ability to juggle the search columns when you have done the search - so that when you pull you data into an excel document it is lined up and ready to go"	Modifying use of a currently used feature	This code refers to the act of modifying a currently used feature, for example, improving the way the feature is used or using it in a more sophisticated manner.
"… you can look through call activities on the tab and find out when an order was placed, but it doesn't actually tell you exactly what was on the order…so a customer may ring up and say I ordered some [product name] a little while ago. So instead of having to go through all of their orders from call activities [using the tab], you can just go to the tree, click on orders, find the product, and go straight to the order."	Substituting an already used feature with another feature	This code refers to the act of replacing one feature with another to perform a similar task.
"..I'm using the ITSM to store information related to that [project] - just some short notes and some URLs, some videos that are around - so I've created a page for my own kind of personal record of that topic."	Innovative Use of a Feature	This code refers to the act of using a feature in a novel and/or innovative manner. The feature tends to be used in an unusual but effective manner

"I learn a lot by just watching. So every time I needed something done I would just watch them [peers] do it as well…"	Peer Observation	This code refers to users learning by observing other colleagues (e.g. peers, supervisors, expert users)
"One of my work mates showed me [how to use a particular feature]….Well I thought that was the only way you could do it and he just said, "Oh no, once you've got that trancept information in there from the GPS you can just click this other button and it puts it in automatically… he saw me doing it and said, 'Oh no, it's quicker to do it this way'	Suggestion from Peers	This code refers to learning by way of suggestion from colleagues (e.g. peers, supervisors, expert users)
"Sometimes I'll ask [for help] if I needed it, [for example] there was something wrong … So I went to them [team leaders] and asked, "How can I just pull these customers out so I can have a look at them and adjust what needs to be adjusted?"	Asking peers for help	This code refers to users asking colleagues (e.g. peers, supervisors, expert users) for help
"[They] did formal training basically around the new features and the monitors were mentioned. So he gave us quick run through of how you can set them up and then we went away and set them up so it was specific to our role to the point now where we've got monitors set up for change management and for the service desk guys - for their cues and stuff… they gave you a quick overview of some of the reports you can do.."	Training	This code refers to learning via formal on-going training provided by the organization, typically through an in-house trainer, the IS department or vendor.
"I know that when I did go and ask a question to [IS Person's name], they would generally give me feedback on how to do something and to better utilize the tools"	Seeking assistance from designed IS Support person	This code refers to change being facilitated by guidance provided by a designated IS support personnel (excluding formal training sessions).
"When you know that you're meant to be able to do something.. you just keep on trying to find a way to make it work, if you know that it should be able to to"	Self-starting search behaviour	This code refers to the users' self-driven or starting determination and/or push to find ways to use the IS to accomplish a particular task.

"Even if you've never been shown a feature by the boss or the trainer, you can probably still find that feature and use it properly. Just a process of elimination and just the desire to want to see if you can find it, as opposed to, 'Oh no, I don't how to find that."	Desire to learn and explore the IS	This code refers to the users' innate desire to know or learn more about the IS.
"Started using the quote tab, so you can keep an eye who is ringing the Customer Centre to get quotes on products. So you're using it as a sales tool because it sort of alerts you to who is wanting prices on different products when they may not have rung directly, so they ring the Customer Centre…the boss said to me to start checking the quote tab. So it was sort of a directive really, rather than I just stumbled on it"	Management Directives	This code refers to when a user is mandated or directed to make changes in their use of the IS
"The calendar… I wasn't using it all in the beginning but I didn't realize that our performance is measured on that, so once I found that out I worked out how to use the calendar and I keep doing that now"	Incentive	This code refers to when a user engages in use of a particular feature to gain some incentive or external organizational reward, e.g. performance incentive, verbal reward, recognition, positive performance appraisal.
"I actually use it a lot more now…knowing where to go, what to press…"	Knowledge of IS Features	This code refers to the user's knowledge and/or understanding of the System features.
" I really got my head around exactly what went where and how the whole thing fitted in…. understanding the relationship between the request and tasks…And understand where the synergies were"	Knowledge of Wo Processes	This code represents the user's knowledge of the business and of the processes that support work tasks and/or the operations of the IS. It includes a holistic view as opposed to a siloed view of one's work processes, which aids in ensuring a greater connection (or integration) between various tasks and the IS.

"if you do see a new feature or function see what it does. And from that, you can determine whether it is of any help to you or not"	Feature Selection	This code represents users choosing to use a feature for their work
"…found some other tabs and it can benefit the way I do my job"	Potential Benefit of feature	This code refers to a user perception of the benefit of a feature
"…just knowing what you need to know and what you don't…What might lead to a sale maybe, what will and won't add value to his farm".	Potential value of feature	This code refers to a user's perception of the value of a feature in achieving a goal
"I use [feature name] a lot…been very good for us in the field… make it easier to operate	Continued Use of a feature	This code represents the user incorporating a feature into their work routine that is the way in which they will regularly do theiwork or the particular task
"in using it [the feature] to work … the most effective way.	Effectiveness	This code represents where use of a feature produces a desired result
"[name of feature]…it's just like a tally of the number of clients that have used that transporter ever. Its really good, it's really work"	Positive evaluation of feature after using it	This code refers to the user's positive evaluation of a feature after using it.
"… lot more efficient in recording what happens at a farm visit, pre-booking appointments and put them in your calendar; that sort of thing"	Efficiency	This code represents reducing the amount of time or effort required to do a task by using particular feature(s)
"… [I am] using more and more of the features"	Using more features in the System	This code represents user using more features in their work
"*Things I use a lot, the fertilizer recommendation, they are very good. The ability to integrate it with emailing, emailing fertilizer plans, customer history, very good for sorting out your customer database into certain groups."*	Integrated use	This code represents the use of features in a integrated manner

Appendix G. Final Set of Themes extracted

Theme	Underlying codes	Definition
Variation	Trying New Features, Modifying use of feature, Substituting an already used feature with another feature, Innovative Use of Feature	Variation, in this context introduces alternatives in how the IS can be used to accomplish work tasks, and represents a departure from how one currently performs a routine (i.e. actions) using the IS. It included a number of action discussed by users- which included trying New Features, modifying use of feature, substituting an already used feature with another feature, and finding innovative ways to use particular features.
Selection	Feature Selection	This code represents users choosing to use a feature for their work
Retention	Continued Use of a feature	This code represents the user incorporating a feature in their routine- that is in which they will regularly do their work or the particular task.
<u>Factors influencing Variation</u>		
Peer Learning	Peer Observation, Suggestion from Peers and Asking peers for help,	Peer Learning includes users learning from colleagues (e.g. peers, supervisors, expert users) in the organization
IS Support	Training and Seeking assistance from designed IS Support person	IS support encapsulates formal on-going training provided by the organization, typically through an in-house trainer, the IS department or vendor and guidance provided by a designated IS support person.

Intrinsic Motivation	Self-starting search behaviour, Desire to learn and explore the IS	Users engaging in exploring the IS for the inherent satisfaction rather than because of external prods, pressure or rewards.
Extrinsic Motivation	Management Directives, Incentive	This involves user engaging in variations for some external reason such as a mandated change/directives or to receive an incentive.
Domain relevant knowledge	Knowledge of IS Features and Knowledge of Wo Processes	Domain relevant knowledge entails both knowledge of IS features and the work processes

Factors influencing Selection

Perception of Benefits	Benefit of feature, Potential value of feature	This code refers to users' evaluation of the value and/or benefit of a feature

Factors influencing Retention

Satisfaction	Effectiveness, Positive evaluation of feature after using it, Efficiency	This code refers to the user's satisfaction with a feature in meeting goals or solving problems

Outcome of Change

Deeper Use	Using more features in the System, Integrated use	This code refers to users using the IS in a more comprehensive manner

Appendix H. Sample Data Display to Identify Relationships

Description	**Supporting Quotes**	**Researcher Notes**
Refining use of 'Search' feature	*"I guess one I learnt from a coworker was being able to search on phone numbers to find a customer. The incident were I was talking to a customer and was barely into the call and I haven't gotten to asking for the customer number at that stage. And then for some reason the call got dropped, but I had written down his phone number from the caller id on the telephone. And, it was the only bit of information I had. And so, I thought what do I do with this? how can I find this?. And that was when a co-worker said to me- actually if you go into this part of the CRM, you can search on the phone numbers and after you type in the phone number- the CRM starts looking at the phone number and it will look at those and then we can narrow it down to which customer"*	This text segment reflected the user modifying/refining their use of the search feature which was facilitated through peer learning
Using 'Call Activities' feature	*"[I was taught by the trainer], before I go and see a client I will look at their call activities and it just gives you an indication of maybe if they've called the Customer Centre with a complaint or something, or they've just ordered something that'll show up on there"*	This text segment reflected the user using a new feature 'call activities' which was facilitated by training

Use of Merging Feature Record	*"I just taught myself by fiddling …customers rang to set up an account and before we set them up, we have to search to make sure they are not already in the system. And I found they were already in the system and that they were in there twice. …I just think that rather than setting up a 3rd account, it makes sense to use the information that was already there, but to collate it …I knew there must be a way to merge it…So I just went through each option trying to find..I found it and then it basically comes up in a step-by-step pattern, so it was quite easy to do"*	This text segment reflected the user's self-determination to use the IS to merge customer records.
Use of [Quote] Follow-up Feature	*"Well, what happened was we would do pricing for customers and we'd never follow it up. So the company decided, well, these people are ringing for a price, we need to follow up in two days' time if they want an order because they might not think we want their business"*	This text segment reflected the user's use of a feature in response to management directive
Use of Calendar feature	*"The calendar… I wasn't using it all in the beginning but I didn't realize that our performance is measured on that, so once I found that out I worked out how to use the calendar and I keep doing that now"*	This text segment reflected the user's use of a feature to gain positive performance appraisal.
Use of Soil Testing feature	*"The soil test is really handy 'cause you can see all their past results there. So you can get an idea of where their facility [is] or what their facility is…it is handy to see their sort of farm basic map so you can see where the soil tests have been done in the past. And you can also tell their soil type…which is helpful"*	This text segment represents the user's evaluation a feature after using it and the criteria used in guiding the decision (outcome).

Appendix I: Construct Definition and Measures

Variation

(Shaded row represents definitions and measures used in this research)

Source	**Definition**	**Measures**	**Scale**

	Experiments with (i) different ways of using the System features to support one's work' and/or (ii) different ways to do one's work to accommodate the System' (Self-Developed)	***<u>Overall (Variation)</u>***
		• **[Var1]** Overall, thinking back to when I first started, I have tried out many different ways to use or accommodate the LMS in in my job
		(*Strongly Disagree [1] to Strongly Agree [7])*
		• Overall, thinking back to when you first started, how much have you experimented with different ways of using or accommodating the LMS in your job?
		  • **[Var2]** None [1] at all to A Great Amount [7]
		  • **[Var3]** Not at all [1] to A Very Great Extent [7]
		(*7-point Likert scale)*
		(Self-Developed items)
			7-point Likert scale (See Column 3 for endpoints)

		<u>Variation (Features)</u> In using the LMS, how much have you experimented with: • **[VarF1]** using new features to support your work? • **[VarF2]** changing how you use current features for your work? • **[VarF3]** substituting (replacing) features you have been using with other LMS features to do your work? • **[VarF4]** using various features in new ways to do your work? • **[VarF5]** using different features in innovative ways (i.e. unusual and effective) for your work? **(Self-Developed items)**	(7-point Likert scale, Not at all to A Great Amount)

Variation (Cont'd)

Source	Definition	Measures	Scale
		Variation (Work Processes) To accommodate the LMS in your work, how much have you experimented with: • **[VarWP1]** restructuring the way you do your job? • **[VarWP2]** creating new ways to do your work? • **[VarWP3]** creating innovative ways (i.e. unusual and effective) to do your work? **(Self-developed items)**	(7-point Likert scale, Not at all to A Great Amount)
Aldrich (1999)	Any departure from routine or tradition (p. 17)	No Measures	Definition of variation (in a general sense)
Zollo and Winter (2002)	Where individuals or groups of them generate a set of ideas on how to approach old problems in novel ways or to tackle relatively new challenges (p. 343)	No Measures	Definition of variation (in a general sense)
Furneaux (2010)	The process by which existing varieties are retained in organizational memory	No Measures	Definition of variation (in a general sense)

Retention

(Shaded row represents definitions and measures used in this research)

Source	**Definition**	**Measures**	**Scale**

	Preserving a change (i.e. a selected variation) in one's work routine (Self Developed	***<u>Retention (Overall)</u>***
		• **[RT1]** Overall, thinking back to when I first started, most of the Variations I have experimented with *(in using or accommodating the LMS in my job)* have been INCLUDED in my work routine
		(*7-point Likert scale: 'Strongly Disagree to Strongly Agree)*
		• Overall, thinking back to when you first started, of the Variations you have experimented with (*in using or accommodating the LMS in your job)* how much have you INCLUDED in your work routine?
		  • **[RT2]** None at all [1] to A Great Amount [7]
		  • **[RT3]** Not at all [1] to A Very Great Extent [7]
		(*7-point Likert scale)*
		• **[RT4]** Overall, thinking back to when you first started, of the Variations you have tried out *(in using or accommodating the LMS in your job)* approximately what % have you ADOPTED into your work routine?
		(Self-developed items)
			7-point Likert scale for RT1 to RT3 (See Column 3 for endpoints)

		<u>Retention (of Variation in Features)</u> In using the LMS, how much of the following Variations have you INCLUDED in your work routine: • **[RTF1]** new features you have used to support your work? • **[RTF2]** changes in how you use current features to do your work? • **[RTF3]** substitution (replacement) of features you have been using with other LMS features to do your work? • **[RTF4]** new ways of using various features to do your work? • **[RTF5]** innovative ways (i.e. unusual and effective) of using different features to support your work? **(Self-developed items)**	(7-point Likert scale, Not at all to A Great Amount)

Retention (Cont'd)

Source	Definition	Measures	Scale
		Retention (of Variation in Work Processes) To accommodate the LMS in your work, how much of the following Variations have you INCLUDED in your work routine: • **[RTWP1]** restructuring in the way you do your job • **[RTWP2]** new ways you have created to do your work • **[RTWP3]** innovative ways (i.e. unusual and effective) you have created to do your work **(Self-developed items)**	**(**7-point Likert scale, Not at all to A Great Amount)
Aldrich (1999)	Selected variations are preserved, duplicated, or otherwise reproduced (p. 17)	No measures	
(Furneaux et al., 2010)	The process by which existing varieties are retained in organisational memory (p. 34)	No measures	

Intrinsic Motivation (Overall)

(Shaded row represents definitions and measures used in this research)

Source	Definition	Measures	Scale
	Doing of an activity for its inherent satisfactions rather than for some separable consequence (Ryan and Deci, 2000)	My motivation to experiment with Variations based on **internal needs** (e.g. *needs for fun, discovery, achievement, outdoing others, self-improvement*) is: • **[IntMv1]** Very Weak to Very Strong • **[IntMv2]** Very Low to Very High **(Self-developed items,** *7-point semantic differential scales***)**	7-point differential semantic scale
(Amabile et al., 1994)	To engage in work primarily for its own sake because the work is interesting, engaging and in some cases satisfying	1. I enjoy tackling problems that are completely new to me 2. I enjoy trying to solve complex problems 3. The more difficult the problem, the more I enjoy trying to solve it 4. I want my work to provide me with opportunities for increasing my knowledge and skills 5. Curiosity is the driving force behind much of what I do 6. I want to find out how good I really can be at my work 7. I prefer to figure things out for myself 8. What matters most to be is enjoying what I do 9. It is important for me to have an outlet for self-expression 10. No matter what the outcome of a project, I am satisfied if I feel I have gained a new experience 11. I'm more comfortable when I can set my own goals 12. I enjoy doing work that it is so absorbing that I forget about everything else 13. It is important for me to be able to do what I most enjoy	4-point Likert scale (never or almost never true of me to always or almost always true of me)

Intrinsic Motivation (Overall) (Cont'd)

Source	Definition	Measures	Scale
(Ryan & Deci, 2000a)	The doing of an activity for its inherent satisfactions rather than for some separable consequence. When intrinsically motivated a person is moved to act for the fun or challenge entailed rather than because of external prods, pressures, or rewards	Theoretical Paper (No data collection)	
(Vallerand et al., 1992)	It refers to engaging in an activity for its own sake and the experience of pleasure and satisfaction derived from participation	Measures not provided	
(Davis, Bagozzi, & Warshaw, 1992)	Performance of an activity for no apparent reinforcement other than the process of performing the activity per se	1. I would find using XXX to be enjoyable (likely/unlikely) 2. Using XXX would be unpleasant/pleasant 3. I would have fun using XXX (likely/unlikely)	7-point Likert scale
(Guay et al., 2000)	Intrinsically motivated behaviors are those that are engaged in for their own sake, in other words, for the pleasure and satisfaction derived from performing them	Why are you currently engaged in this activity? 1. Because I think that this activity is interesting 2. Because I think that this activity is pleasant 3. Because this activity is fun 4. Because I feel good when doing this activity	7-point Likert scale (Corresponds not all to corresponds exactly)
(Zhang & Bartol, 2010)	The extent to which an individual is interested in a task and engages in it for the sake of the task itself	1. I enjoy finding solutions to complex problems 2. I enjoy creating new procedures for new tasks 3. I enjoy improving existing processes or products	5-point Likert scale (Strongly Disagree to Strongly Agree)
(Ryan & Connell, 1989)	The behavior is done simply for its inherent enjoyment or for fun	1. Because it's fun 2. Because I enjoy it	5-point Likert scale (To no extent-to a very great extent)

Intrinsic Motivation (Overall) (Cont'd)

Source	Definition	Measures	Scale
(Ntoumanis, 2001)	Intrinsically motivated behaviours can occur without external rewards (e.g., trophies), are undertaken out of interest in the activity itself rather than the outcomes of the activity, and are optimally challenging	I take part in this PE [Physical Education] class... 1. Because PE is fun 2. Because I enjoy learning new skills 3. Because PE is exciting 4. Because of the enjoyment that I feel while learning new skills/techniques	7-point Likert scale
(Tierney, Farmer, & Graen, 1999)	The individual's orientation or level of enthusiasm for the activity.	Please indicate the extent to which you agree or disagree that each statement currently describes your self-orientation: 1. I enjoy finding solutions to complex problems. 2. I enjoy coming up with new ideas for products. 3. I enjoy engaging in analytical thinking 4. I enjoy creating new procedures for work tasks. 5. I enjoy improving existing processes or products	6-point Likert scale
(Pelletier, Tuson, & Haddad, 1997)	Intrinsically motivated behaviors are those that are engaged in purely for the pleasure and satisfaction derived from their pleasure. They are performed voluntarily in the absence of material rewards or external constraints.	1. For the pleasure I experience when I feel completely absorbed in a therapy session 2. For the satisfaction I have when I try to achieve my personal goals in the course of therapy 3. Because I experience pleasure and satisfaction when I learn new things about myself that I didn't know before 4. For the interest I have in understand more about myself	7-point Likert scale (Strongly Disagree to Strongly Agree)

Intrinsic Motivation to Know

(Shaded row represents definitions and measures used in this research)

Source	Definition	Measures	Scale
	Performing an activity for the pleasure and the satisfaction that one experiences while learning, exploring, or trying to understand something new (Vallerand et al., 1995).	When experimenting with Variations: • **[IMKnw1]** I get enjoyment from learning new things (Guay et al., 2003) • **[IMKnw2]** I receive satisfaction from acquiring new knowledge (Guay et al., 2003) *(7-point Likert scale, Strongly Disagree to Strongly Agree)*	7-point Likert scale (Strongly Disagree to Strongly Agree)
(Guay, Mageau, & Vallerand, 2003)	None Provided	In general, I do things . . . 1. … Because I like making interesting discoveries. 2. ... For the pleasure of acquiring new knowledge. 3. ... For the pleasure of learning new, interesting things. 4. .. For the pleasure of learning different interesting facts	7-point Likert scale (Does not correspond at all to Correspond exactly)
(Pelletier et al., 1995)	Performing an activity for the pleasure and the satisfaction that one experiences while learning, exploring, or trying to understand something new.	Why Do You Practice Your Sport? 1. For the pleasure it give me to know more about the sport I practice 2. For the pleasure of discovering new training techniques 3. For the pleasure that I feel while learning training techniques that I have never tried before 4. For the pleasure of discovering new performance strategies	7-point Likert scale (Does not correspond at all to Correspond exactly)
(Li, 1999)	(See Pelletier et al., 1995, for detailed definition of each construct).	Why are you currently participating in this activity?" 1. For the satisfaction it gives me to increase my knowledge about this activity 2. For the pleasure I experience while learning about this activity 3. For the pleasure of understanding this activity 4. Because I enjoy the feelings of discovering more about this activity	6-point Likert scale, ranging from 1 (Strongly Disagree) to 6 (Strongly Agree)

Intrinsic Motivation to Know (Cont'd)

Source	Definition	Measures	Scale
(Van Yperen & Hagedoorn, 2003)	None Provided	Why do you do this job?" 1. For the pleasure it gives me to know more about my work 2. For the pleasure of doing new things in my work 3. For the pleasure I feel while learning new things in my work 4. For the pleasure of developing new skills in my work	7-point Likert scale (Strongly Disagree to Strongly Agree)
(Li et al., 2013)	The pleasure and satisfaction that users experience when learning new things or trying to understand something new in using IS.	"Why do you use the BIS (business intelligence system)?" 1. For the pleasure it gives me to know more about the BIS. 2. For the pleasure I feel while learning new things when using the BIS. 3. For the pleasure of developing new skills when using the BIS.	7-point Likert scale (Strongly Disagree to Strongly Agree)

Intrinsic Motivation toward Accomplishment

(Shaded row represents definitions and measures used in this research)

Source	Definition	Measures	Scale
	Engaging in an activity for the pleasure and satisfaction experienced when one attempts to accomplish or create something (Vallerand et al., 1995)	When experimenting with Variations: 1. **[IMAcp1]** I experience satisfaction from outdoing myself (Guay et al., 2003) 2. **[IMAcp2]** I experience satisfaction from surpassing myself (Guay et al., 2003) *(7-point Likert scale, Strongly Disagree to Strongly Agree)*	7-point Likert scale (Strongly Disagree to Strongly Agree)
(Vallerand et al., 1989)	—	Why do you go to college? 1. For the pleasure I experience while surpassing myself in my studies. 2. For the pleasure that experience while I am surpassing myself in one of my personal accomplishments. 3. For the satisfaction I feel when I am in the process of accomplishing difficult academic activities 4. Because college allows me to experience a personal satisfaction in my quest for excellence in my studies.	7-point Likert scale (Does not correspond at all to Corresponds exactly)
(Guay et al., 2003)	None Provided	IN GENERAL, I DO THINGS … 1. ... because of the pleasure I feel as I become more and more skilled 2. …for the pleasure I feel mastering what I am doing. 3. …because of the satisfaction I feel in trying to excel in what I do 4. … because of the pleasure I feel outdoing myself	7-point Likert scale (does not correspond at all to (correspond exactly).
(Pelletier et al., 1995)	IM toward accomplishment can be defined as engaging in an activity for the pleasure and satisfaction experienced when one attempts to accomplish or create something.	Why Do You Practice Your Sport? 1. Because I feel a lot of personal satisfaction while mastering certain difficult training techniques 2. For the pleasure I feel while improving some of my weak points. 3. For the satisfaction I experience while I am perfecting my abilities 4. For the pleasure that I feel while executing certain difficult movements.	7-point scale (Does not correspond at all to Correspond exactly)

Intrinsic Motivation toward Accomplishment (Cont'd)

Source	Definition	Measures	Scale
(Li, 1999)	(See Pelletier et al., 1995, for detailed definition of each construct).	Why are you currently participating in this activity?" 1. For the pleasure of mastering this activity 2. For the satisfaction I feel while I try to achieve my personal goals during the course of this activity 3. Because I enjoy the feelings of improving through participating in this activity 4. For the pleasure I experience while trying to become the person I want to be	7-point Likert scale with anchors ranging from strongly disagree (1) to strongly agree (7).
Van Yperen & Hagedoorn, 2003)	None Provided	Why do you do this job?" 1. Because I feel a lot of personal satisfaction while mastering certain difficult work skills 2. For the pleasure I feel while improving some of my weak points on the work 3. For the pleasure I feel while I am perfecting my work skills 4. For the satisfaction I feel while overcoming certain difficulties in my work	7-point Likert scale, ranging from Strongly Disagree (1) to Strongly Agree (7)
(Li et al., 2013)	The pleasure and satisfaction that users experience when solving problems or overcoming difficulties in using IS	"Why do you use the business intelligence system (BIS)?" 1. Because I feel a lot of personal satisfaction while mastering certain difficult skills in using the BIS. (dropped) 2. For the pleasure I feel while improving some of my weakness in using the BIS 3. For the satisfaction I experience while I am perfecting my use of the BIS. 4. For the satisfaction I feel while overcoming certain difficulties in using the BIS.	7-point Likert scale (Strongly Disagree to Strongly Agree)

Intrinsic Motivation to experience Stimulation

(Shaded row represents definitions and measures used in this research)

Source	Definition	Measures	Scale
	Engaging in an activity in order to experience stimulating sensations (Vallerand et al., 1995)	When experimenting with Variations: • [**IMSt1]** I get enjoyment from fulfilling my intrinsic need for fun • **[IMSt2]** I get pleasure from advancing my need for fun • **[IMSt3]** I receive satisfaction from supporting my internal need for enjoyment **(Self-developed items,** *7-point Likert scale, Strongly Disagree to Strongly Agree*)	7-point Likert scale (Strongly Disagree to Strongly Agree)
(Vallerand et al., 1992)	IM-to experience stimulation is operative when someone engages in an activity in order to experience stimulating sensations (e.g. sensory pleasures, aesthetic experiences, as well as fun and excitement) derived from one's engagement in the activity"	Not Provided	
(Guay et al., 2003)	None Provided	In general, I do things . . . 1. …in order to feel pleasant emotions. 2. ... because of the sense of well-being I feel while I am doing them 3. ... for the pleasant sensations I feel while I am doing them 4. ... for the enjoyable feelings I experience	7-point Likert scale (does not correspond at all to corresponds exactly)
(Vallerand et al., 1989)	None Provided	Why do you go to College? 1. For the intense feelings I experience when I am communicating my own ideas to others 2. For the pleasure I experience when I read interesting authors 3. For the pleasure that I experience when I feel completely absorbed by what certain authors have written 4. For the "high" feeling that I experience while reading about various interesting subjects	7-point Likert scale (Does not correspond at all to Corresponds exactly)

Intrinsic Motivation to experience Stimulation (Cont'd)

Source	Definition	Measures	Scale
Van Yperen & Hagedoorn, 2003)	None Provided	Why do you do this job? 1. Because I feel pleasant in my work 2. For the excitement I feel when I am really involved in my work 3. For the intense pleasure I feel while I am doing the tasks that I like 4. Because I like the feeling of being totally immersed in my job	7-point Likert scale (Strongly Disagree to Strongly Agree)
(Pelletier et al., 1995)	IM to Experience Stimulation occurs when someone engages in an activity in order to experience stimulating sensations (e.g., sensory pleasure, aesthetic experiences, as well as fun and excitement) derived from one's engagement in the activity	Why Do You Practice Your Sport? 1. For the pleasure I feel in living exciting experiences. 2. For the excitement I feel when I am really involved in the activity. 3. For the intense emotions I feel doing a sport that I like. 4. Because I like the feeling of being totally immersed in the activity	7-point Likert scale (Does not correspond at all to Correspond exactly)
(Li, 1999)	(See Pelletier et al., 1995, for detailed definition of each construct).	Why are you currently participating in this activity?" 1. For the pleasure it gives me to experience positive sensations from the activity 2. For the satisfaction I feel when I get into the flow of this activity 3. For the pleasure I experience when I feel completely absorbed in this activity 4. For the enjoyment that comes from how good it feels to do this activity	7-point Likert scale (Strongly Disagree to Strongly Agree)
(Li et al., 2013)	The pleasure and satisfaction that users experience when interacting with IS.	Why do you use the BIS? 1. I find using the BIS to be enjoyable. 2. The actual process of using the BIS is pleasant. 3. I have fun using the BIS.	7-point Likert scale (Strongly Disagree to Strongly Agree)

Extrinsic Motivation (Overall):

(Shaded row represents definitions and measures used in this research)

Source	Definition	Measures	Scale
	The performance of an activity because it is perceived to be instrumental in achieving valued outcomes that are distinct from the activity itself, such as improved job performance, pay, or promotions (Davis et al., 1992)	My motivation to experiment with Variations based on **external needs** *(e.g. complying with management, work requirements, to avoid punishment or to receive rewards and incentives)* is: • **[ExtMv1]** Very Weak to Very Strong • **[ExtMv2]** Very Low to Very High **(Self-developed items,** *7-point semantic differential scale***)**	*7-point semantic differential scale*
(Davis et al., 1992)	The performance of an activity because it is perceived to be instrumental in achieving valued outcomes that are distinct from the activity itself, such as improved job performance, pay, or promotions	1. Using WriteOne would improve my performance in the MBA program 2. Using WriteOne in the MBA program would increase my productivity 3. Using WriteOne would enhance my effectiveness in the MBA program 4. I would find WriteOne useful in the MBA program."	7-point Likert scale (Likely to Unlikely)
(Amabile et al., 1994)	The motivation to work primarily in response to something apart from the work itself, such as reward or recognition or the dictates of other people"	1. I am strongly motivated by the [grades] [money] I can earn 2. I am keenly aware of the [GPA (grade point average)] [promotion] goals I have for myself 3. I am strongly motivated by the recognition I can earn from other people 4. I want other people to find out how good I really can be at my work	4-point scale (never or almost never true of me to always or almost always true of me
(Li et al., 2013)	Perceived Usefulness as Extrinsic Motivation Toward IS Use (users' perceptions of whether using IS will effectively enhance their work performance)	1. Using the BIS in my job enables me to accomplish tasks more quickly. 2. Using the BIS improves my job performance. 3. Using the BIS in my job increases my productivity. 4. Using the BIS enhances my effectiveness in my job.	7-point Likert scale (Strongly Disagree to Strongly Agree)

External Regulation

(Shaded row represents definitions and measures used in this research)

Source	Definition	Measures	Scale
	Behaviors are performed to satisfy an external demand or obtain an externally imposed reward contingency (Ryan and Deci, 2000)	1. **[ExtReg1]** I am supposed to experiment with Variations (Ryan and Connell, 1989) 2. **[ExtReg2]** Experimenting with Variations is something that I have to do (Guay et al., 2000) 3. **[ExtReg3]** I feel that I have to experiment with Variations adapted (Guay et al., 2000) *(7-point Likert scale, Strongly Disagree to Strongly Agree)*	7-point Likert scale (Strongly Disagree to Strongly Agree)
(Ryan & Connell, 1989)	Focus on avoidance of punishment or compliance with proscriptions	1. Because that's what I'm supposed to do? 2. So that the teacher won't yell at me 3. Because that's the rule 4. So others won't get mad at me	4-point Likert-type scales.
(Guay et al., 2000)	External regulation occurs when behavior is regulated by rewards or in order to avoid negative consequences	1. Because I am supposed to do it 2. Because it is something that I have to do 3. Because I don't have any choice 4. Because I feel that I have to do it	7-point Likert scale (not at all in agreement to completely in agreement)
(Pelletier et al., 1995)	Behavior that is controlled by external sources, such as material rewards or constraints imposed by others	Why Do You Practice Your Sport? 1. Because it allows me to be well regarded by people that I know 2. For the prestige of being an athlete. 3. Because people around me think it is important to be in shape. 4. To show others how good I am good at my sport	7-point scale (Does not correspond at all to Correspond exactly)

External Regulation (Cont'd)

Source	Definition	Measures	Scale
(Li, 1999)	None provided- author's note: see Pelletier et al (1995) for detailed definition of each construct.	Why are you currently participating in this activity?" 1. Because other people believe that it's a good idea for me to exercise 2. Because I feel pressure from others to participate 3. To satisfy people who want me to exercise 4. To comply with expectation of others (e.g. friends)	7-point Likert scale (Strongly Disagree to Strongly Agree)
(Tremblay, Blanchard, Taylor, Pelletier, & Villeneuve, 2009)	Doing an activity only to obtain a reward.	1. For the income it provides me 2. Because it allows me to earn money 3. Because this type of work provides me with security	5-point Likert scale (does not correspond at all to corresponds exactly)

Introjected Regulation

(Shaded row represents definitions and measures used in this research)

Source	Definition	Measures	Scale
	This is a type of internal regulation that is still quite controlling because people perform such actions with the feeling of pressure in order to avoid guilt or anxiety or to attain ego-enhancements or pride (Ryan and Deci, 2000a)	1. **[IJReg1]** People who are important to me think that I should experiment with Variations 2. **[IJReg2]** People whose opinions matter to me think that I should experiment with Variations **(Self-developed items,** *7-point Likert scale, Strongly Disagree to Strongly Agree*)	7-point Likert scale (Strongly Disagree to Strongly Agree)
(Ryan & Connell, 1989)	Notion of introjection connotes a formerly external regulation or value that has been "taken in" and is now enforced through internal pressures such as guilt, anxiety, or related self-esteem dynamics. Through introjection, reliance on environmental regulation is minimized and replaced by new and quite different affective determinants and qualities. However, it still retains a quality of pressure and conflict, or a lack of complete integration with the self.	1. Because I want the teacher to think I'm a good student 2. Because I will feel bad about myself if I don't 3. Because I'll feel ashamed of myself if I don't 4. Because I want the other students to think I'm smart 5. Because it bothers me when I don't 6. Because I want people to like me	4-point Likert scales.
(Malhotra et al., 2008)	Introjected PLOC is often associated with strong self-imposed feelings of coercion that might lead to rejection of the “imposed” behavior	1. . . Because it bothers me when I don’t use the system. 2. . . . Because I will feel bad about myself if I don’t use the system. 3. . . . Because I’ll feel ashamed of myself if I don’t use the system. 4. . . . Because I want my colleagues to like me. 5. . . . Because my friends would think that I should use the system. 6. . . . Because my peers would think that I should use the system. 7. . . . So that others won’t get upset with me. 8. . . . Because I want the instructor to think that I’m a good student.	7-point Likert scale (Strongly Disagree to Strongly Agree)
(Tremblay et al., 2009)	The regulation of behaviour through self-worth contingencies (e.g., self-esteem, guilt).	1. Because I want to succeed at this job, if not I would be very ashamed of myself. 2. Because I want to be very good at this work, otherwise I would be very disappointed. 3. Because I want to be a “winner” in life.	7-point Likert scale (Does not correspond at all to corresponds exactly)

Introjected Regulation (Cont'd)

Source	Definition	Measures	Scale
(Guay et al., 2003)	Introjected regulation refers to behaviors that are in part internalized by the person.	In general, I do things . . . 1. ... because I would beat myself up for not doing them. 2. ... because otherwise I would feel guilty for not doing them 3. ... because I force myself to do them. 4. … because I would feel bad if I do not do them.	7-point Likert scale (Does not correspond at all to corresponds exactly).
(Pelletier et al., 1995)	With introjection, the formerly external source of motivation has been internalized such that its actual presence is no longer needed to initiate behavior. Instead, these behaviors are reinforced through internal pressures such as guilt or anxiety	Why do you practice your sport? 1. Because it is absolutely necessary to do sports if one wants to be in shape. 2. Because I must do sports to feel good myself. 3. Because I would feel bad if I was not taking time to do it. 4. Because I must do sports regularly.	7-point Likert scale (Does not correspond at all to Correspond exactly)

Identified Regulation

(Shaded row represents definitions and measures used in this research)

Source	Definition	Measures	Scale
	The person has identified with the personal importance of a behavior and has thus accepted its regulation as his or her own. Regulation	1. **[IDReg1]**Experimenting with Variations is important for me (Guay et al., 2000) 2. **[IDReg2]** I believe that experimenting with Variations is good for me (Guay et al., 2000) 3. **[IDReg3]** Experimenting with Variations is of value to me (Self-developed) *(7-point Likert scale, Strongly Disagree to Strongly Agree)*	7-point Likert scale (Strongly Disagree to Strongly Agree)
Guay et al (2000)	Identified regulation occurs when a behavior is valued and perceived as being chosen by oneself	1. Because I am doing it for my own good 2. Because I think that this activity is good for me 3. By personal decision 4. Because I believe that this activity is important for me	7-point Likert scale (Does not correspond at all to corresponds exactly).
Tremblay et al., 2009)	Doing an activity because one identifies with its value or meaning, and accepts it as one's own	1. Because this is the type of work I chose to do to attain a certain lifestyle. 2. Because I chose this type of work to attain my career goals. 3. Because it is the type of work I have chosen to attain certain important objectives	7-point Likert scale (Does not correspond at all to corresponds exactly).
(Mullan & Markland, 1997)	Action undertaken because of its value, importance or usefulness to the individual	5. I value the benefits of exercise 6. It's important to me to exercise regularly 7. I think it is important to make the effort to exercise regularly 8. I get restless if I don't exercise regularly	Not provided

Knowledge (IS Features, Work Process Understanding, & System Feature/Work Understanding)

(Shaded rows represent definitions and measures used in this research)

Source	Definition	Measures	Scale
	(Overall) Domain-related Knowledge Knowledge represents an understanding of the principles by which a system can be applied and adapted to a business task or process (Santhanam et al., 2007)	1. **[Knw1]** I have a lot of background knowledge when it comes to my experimenting with Variations 2. **[Knw2]** I have the know-how for experimenting with Variations **(Self-developed items,** *7-point Likert scale, Strongly Disagree to Strongly Agree*)	7-point Likert scale (Strongly Disagree to Strongly Agree)
	Knowledge of IS Features IS Feature Knowledge represents a conceptual understanding of the system components, that is, features of the system (Santhanam, Seligman and Kang, 2007)	When it comes to my experimenting with Variations: • **[KnwF1]** I know the features of the LMS (Nambisan, 1999) • **[KnwF2]** I understand all aspects of the LMS (Self Developed) (7-point Likert scale, Strongly Disagree to Strongly Agree)	7-point Likert scale (Strongly Disagree to Strongly Agree)
	Work Process Understanding The extent to which users understand how to perform their own work activities in the IS environment and how their work activities fit into other work processes (Jones et al., 2008)	When it comes to my experimenting with Variations: • **[KnwWP1]** I understand how the task(s) I do fit into the overall work process • **[KnwWP2]** I understand the overall work process that my task(s) is part of *(Jones et al., 2008) (7-point Likert scale, Strongly Disagree to Strongly Agree)*	7-point Likert scale (Strongly Disagree to Strongly Agree)
(Nambisan et al., 1999)	Technology Cognizance: This variable relates to a user's knowledge about the capabilities of a technology, its features, potential use, and cost and benefits, i.e., it relates to awareness-knowledge	1. I know the features of the technologies 2. I am aware of the cost of deploying the technologies 3. I don't know the type of benefits that can be derived by deploying the technologies 4. I know the extent of benefits that can be derived by deploying the technologies 5. I don't know the type of business activities in which these technologies have been/can be deployed	7-point Likert scale

Knowledge (IS Features, Work Process Understanding, & System Feature/Work Understanding) (Cont'd)

Source	Definition	Measures	Scale
(Staples, Wong, & Seddon, 2002)	Knowledge of the system- This construct represents the expectation that users will have a good understanding of the system and become confident users of it.	1. I expect to have a good understanding of the new system/I have a good understanding of the system 2. I expect to have a sufficient understanding of the new system/I have a sufficient understanding of the system 3. I will be a confident user of the new system/I am a confident user of the system	Not provided
(Jones et al., 2008)	Work process understanding: The extent to which users understand how to perform their own work activities in the ERP environment and how their work activities fit into other work processes.	Please respond to the following questions about your level of understanding of your own work processes and tasks. a. How the task(s) I do feed into the next task(s) in the work process b. How the task(s) I do fit into the overall work process c. The task(s) that feed into the task(s) I do d. The tasks(s) that my task(s) feed into e. The overall work process that my task(s) is part of	5-point Likert scale (Almost None to Very High)
(Deng, Doll, & Cao, 2008)	Tacit knowledge- An individual's understanding of the work process	1. I have general knowledge of this process for which I am using the software 2. I have expertise on this process 3. I have theoretical understanding of this process	5-point Likert scale (none or a little to a very great extent)

Peer Learning (or Related Concepts)

(Shaded row represents definitions and measures used in this research)

Source	Definition	Measures	Scale
	Peer learning can be defined as the acquisition of knowledge and skill through active helping and supporting among status equals or matched companions (Topping, 2005).	When it comes to my experimenting with Variations: • **[Peer1]** My co-workers have been instrumental in helping me (Ke et al., 2013) • **[Peer2]** I have received a lot of guidance from my co-workers (Ke et al., 2013) • **[Peer3**] My co-workers have helped me a great deal (Self-Developed) • **[Peer4]** I have learned a lot from my co-workers (Yang, 2007) *(7-point Likert scale, Strongly Disagree to Strongly Agree)*	7-point Likert scale (Strongly Disagree to Strongly Agree)
(Ke et al., 2013)	Socialization tactics refer to organization-wide activities—formal or informal social events, such as meetings, training workshops, and user sharing sessions—that instill organizational goals and norms. The information shared at such events can enhance employee identification with the organization and internalization of its norms and values	1. I have been extensively involved with other ES users in ES related activities. 2. Other users have been instrumental in helping me understand ES applications. 3. There is a sense of "being in the same boat" among ES users. 4. I am gaining a clear understanding of my role in applying ES effectively from observing my colleagues. 5. I have received little guidance from experienced colleagues as to how I should explore ES features. 6. I have been generally left alone to discover ES features (reverse coded)	5-point Likert scale (Strongly Disagree to Strongly Agree)

Peer Learning (or Related Concepts) (Cont'd)

Source	Definition	Measures	Scale
(Jones, 1986)	In serial processes, experienced organizational members act as role models for new recruits, but in disjunctive processes newcomers must develop their own definitions of situation because no other or prior role incumbents are available.	Serial versus disjunctive: 1. Experienced organizational members see advising or training newcomers as one of their main job responsibilities in this organization. 2. I am gaining a clear understanding of my role in this organization from observing my senior colleagues 3. I have received little guidance from experienced organizational members as to how I should perform my job. (R) 4. I have little or no access to people who have previously performed my role in this organization. (R) 5. I have been generally left alone to discover what my role should be in this organization (R)	7-point Likert scale (Strongly Disagree to Strongly Agree
(Sun, 2012)	Others' use- One observes others' system use	1. I saw other people's use of that feature 2. Someone showed me a new feature 3. Someone showed me a new way of using a feature I knew	7-point Likert scale (Strongly Disagree to Strongly Agree)
(Ntoumanis, 2001)	(Cooperative Learning) No definition provided, however the author states that motivational climates which emphasize cooperation bring students together to help each other learn and improve	In this PE class... 1. Students help each other learn 2. Students help each other to get better and excel 3. Students work together as a team 4. The PE teacher encourages students to help each other learn	5-point Likert scale
(Xiao, 1996)	Peer Relationship- No definition provided	*1.* My peers help me with information in applying new KSA *2.* My peers care about my applying new KSA on die job.	___

Perceived Resources

(Shaded row represents definitions and measures used in this research)

Source	Definition	Measures	Scale
	The extent to which an individual believes that he or she has the personal and organizational resources needed to use an IS (Mathieson et al., 2001).	**[RS1]** I have the resources, opportunities, and knowledge I need to experiment with Variations **[RS2]** There are no barriers to my experimenting with Variations **[RS3]** I have access to the resources I need to experiment with Variations **[RS4]** I am able to experiment with Variations if I want to **[RS5]** In general, there are enough resources to support my experimenting with Variations *(Mathieson et al., 2001) (7-point Likert scale, Strongly Disagree to Strongly Agree)*	7-point Likert scale (Strongly Disagree to Strongly Agree)
(Mathieson et al., 2001)	Perceived Resources- The extent to which an individual believes that he or she has the personal and organizational resources needed to use an IS. Notice that R is not an attribute of a system alone, but also of the individual's environment	1. I have the resources, opportunities and knowledge, I would need to use a database package in my job. 2. There are no barriers to my using a database package in my job 3. I would be able to use a database package in my job if I wanted to 4. I have access to the resources I would need to use a database package in my job.	7-point Likert scale (Extremely likely to Extremely unlikely)
(Taylor & Todd, 1995)	Perceived Behavioural control (PBC)- Reflects beliefs regarding access to the resources and opportunities needed to perform a behavior or alternatively, to the internal and external factors that impede the performance of the behavior.	1. I would be able to use the CRC 2. Using the CRC is entirely within my control 3. I have the resources and the knowledge and the ability to make use of the CRC	0-7 scale

Perceived Resources (Cont'd)

Source	Definition	Measures	Scale
(Taylor & Todd, 1995)	Facilitating Conditions- Reflects the availability of resources needed to engage in a behavior, such as time, moment or other resources.	1. There will not be enough computers for everyone to use in the CRC 2. For me having enough computers for everyone to use is: (unimportant/important) 3. Printing the CRC will be too expensive 4. For me, being able to print for a low price is (unimportant/important	
(Venkatesh, Morris, Davis, & Davis, 2003)	Facilitating conditions - The degree to which an individual believes that an organizational and technical infrastructure exists to support use of the system.	1. I have the resources necessary to use the system. 2. I have the knowledge necessary to use the system. 3. The system is not compatible with other systems I use. 4. A specific person (or group) is available for assistance with system difficulties.	7-point Likert scale
(Thompson & Higglns, 1991)	Facilitating conditions - "Objective factors, 'out there' in the environment, that several judges or observers can agree make an act easy to do" (Author referred to Triandis, 1980 definition)	1. Guidance is available to me in the selection of hardware and software. 2. A specific person (or group) is available for assistance with software difficulties. 3. Specialized instruction concerning the popular software is available to me. 4. A specific person (or group) is available for assistance with hardware difficulties.	5-point Likert scale (Strongly Disagree to Strongly Agree)

Training

(Shaded row represents definitions and measures used in this research)

Source	Definition	Measures	Scale
	Formal training refers to training that is formally planned by an organization to educate employees about the IS and how it can be used (Self Developed)	When it comes to my experimenting with Variations: • **[TRN1]** I receive good training from my organization • **[TRN2]** The kind of training provided by my organization is satisfactory **(Self-developed items,** *7-point Likert scale, Strongly Disagree to Strongly Agree*)	7-point Likert scale (Strongly Disagree to Strongly Agree)

Feedback Valence

(Shaded row represents definitions and measures used in this research)

Source	Definition	Measures	Scale
	The valence of the feedback is the degree to which the feedback is positive or negative (Ilgen & Davis, 2000)	On the whole, the feedback you receive when you experiment with a Variation is: • **[FBVL1]** Bad to Good • **[FBVL2]** Negative to Positive • **[FBVL3]** Favourable to Unfavourable **(Self-developed items,** *7-point scale, semantic differential scale*)	(*7-point scale, semantic differential*)
(Gaertner, Sedikides, & Graetz, 1999)	No specific definition, but mentioned in their writing: (feedback valence: positive, negative)	The experiment ended with two questions concerning the perceived valence of feedback. Participants were first reminded that "in this study, you responded to the BPI and received feedback about the BPI." Then participants were asked (a) was the feedback you received positive (good) or negative (bad)? (1 = very negative, 9 = very positive); and (b) how pleased or displeased with the feedback did you feel when you received it? (1 = very displeased, 9 = very pleased). Careful debriefing concluded the experimental session	They formed a valence index by averaging participants' responses to the questions "Was the feedback you received positive or negative?" and "How pleased or displeased with the feedback did you feel when you received it?”
(Zhou, 1998)	Feedback valence is the positive or negative outcome of the comparison between an individual's creative performance and situational criteria (p. 262)	The following manipulation check variables were measured in the post task questionnaire. Perceived feedback valence. I obtained perceived feedback valence by averaging three items (a = .78). They were: "I was told that I was more creative than 80% of the pretested U of X students," "Compared with other U of X students, I was not very creative during the first part of the experiment" (reverse scored), and ' 'I am satisfied with my performance on this task.''	7-point Likert scale (Strongly Disagree to Strongly Agree)

Feedback Valence (Cont'd)

Source	Definition	Measures	Scale
(Becker & Klimoski, 1989)	The sign of the feedback message has most often been dichotomized as positive or negative, with positive feedback indicating that one's performance is satisfactory and negative feedback indicating undesirable behavior. (p. 344)	An overall positive feedback score was obtained by summing all the positive dimension scores (i.e., from all sources) and dividing by the total number of positive dimensions, and an overall negative feedback score was likewise obtained by summing all the negative dimension scores and dividing by the total number of negative dimensions	Each item was scored as follows: "Never" = 1, "Rarely" = 2, "'Occasionally'' = 3, "Often" = 4, and "Very often" = 5. Thus, the dimension scores had a range of 1 to 5, with 1 indicating no feedback received with respect to the dimension and 5 indicating very frequent feedback received with respect to the dimension
(Kinicki, Prussia, Wu, & McKee-Ryan, 2004)	No definition, but used the term 'feedback sign.'	Finally, feedback sign was measured by asking respondent to consider the proportion of positive to negative feedback they received. Responses ranged from 1 (100% positive) to 11 (100% negative) and were reverse scored such that high scores reflected positive feedback	
(Herold & Greller, 1977)	No definition but used the term valence	Negative Feedback: 1. You are taken off a job and assigned a poorer one. 2. Your supervisor tells you that you are doing a poor job. 3. You receive a formal report of poor performance. 4. The supervisor really lets you have it. 5. You are moved to a less responsible job. 6. You make a lot of mistakes. 7. You do not do the job as fast as others. 8. The supervisor makes backhanded comments (like "Have a hard night?"). 9. Your co-workers kid you about doing too little. 10. Co-workers tell you you've done something wrong 11. You are told you should be doing something else 12. The supervisor treats you nicely	Participants were asked to indicate how frequently each of the instances of feedback occurred on their own job. . This was done using a seven-point Likert continuum anchored by "Never" and "Extremely Often," with "Occasionally at the midpoint". Provision was made for the individual to indicate which items did not apply to his or her particular job

Feedback Valence (Cont'd)

Source	Definition	Measures	Scale
(Herold & Greller, 1977) (Cont'd)		Positive Feedback : (1) You get a special pay increase. 2. You receive comments about completed jobs 3. You receive a formal report of good performance. Your supervisor tells you that you are doing a good job. 5. You are moved to a more responsible job. 6. You get a raise 7. You have a regular performance with your supervisor 8. The supervisor treats you as an equal	

Satisfaction with Variation

(Shaded row represents definitions and measures used in this research)

Source	Definition	Measures	Scale
	Overall affective evaluation an end-user has regarding his or her experience related with the information system (Chin and Lee, 2000	All things considered, I am _____ with my Variations • **[SATv1]** Very Dissatisfied to Very Satisfied • **[SATv2]** Very Displeased to Very Pleased • **[SATv3]** Very Frustrated to Very Contented • **[SATv4]** Very Disappointed to Very Delighted (Chin and Lee, 2000, *7-point scale, semantic differential*)	7-point Likert scale (Strongly Disagree to Strongly Agree)
(Saga & Zmud, 1994)	Overall affective evaluation an end-user has regarding his or her experience related with the information system.	*1.* How would you rate your satisfaction with *the use of the system? (Very dissatisfied to Very Satisfied)* 2. Are you satisfied with *using the system*? (Extremely Dissatisfied to Extremely Satisfied) 3. All things considered, I am (Very Dissatisfied to Very Satisfied) with using the system	See column 3
(Bhattacherjee, 2001)	Users' affect with (feelings about) prior OBD use. ** OBD- Online Banking Division	How do you feel about your overall experience of ODB use • Very dissatisfied/very satisfied • Very displeased/very pleased • Very frustrated/very contented • Absolutely terrible/Absolutely delighted	7-point Likert scale (Strongly Disagree to Strongly Agree)

Extended Use

(Shaded row represents definitions and measures used in this research)

Source	Definition	Measures	Scale
	Using more of the IS features in order to accommodate a more comprehensive set of work tasks (adapted, Saga and Zmud, 1994)	**[ExtUse1]** Of the **relevant features** of the LMS for supporting your work, about what % are you using? (Percentage) **[ExtUse2]** Of **all the features** that the LMS offers, about what % are you using to support your work? (*Percentage)* **[ExtUse3]** I am using a large percentage (%) of the **relevant** features of the LMS to support my work. (*7-point Likert scale, Strongly Disagree to Strongly Agree)* **[ExtUse4]** I am using a large percentage (%) of **all the features** that the LMS offers to support my work *(7-point Likert scale, Strongly Disagree to Strongly Agree)* **(Self-developed items**)	7-point Likert scale (Strongly Disagree to Strongly Agree)
(Saga & Zmud, 1994)	Using more of the technology's features in order to accommodate a more comprehensive set of work tasks (p. 80)	No Measures	
(Hsieh & Wang, 2007)	Using more of the technology's features to support an individual's task performance. The task performance here includes both existing tasks and a more comprehensive set of work task (p. 217)	In a typical one period: 1. I often use most of the features of the ERP system installed in my org. to support my work 2. I often use more features than the average user of the ERP system installed in my org. to support my work 3. I often use more obscure aspects of the ERP system installed in my org. to support my work	7-point Likert scale (Strongly Disagree to Strongly Agree)

Extended Use (Cont'd)

Source	Definition	Measures	Scale
(Saeed & Abdinnour-Helm, 2008)	The extent to which the users leverage the different features of the IS (p. 378). Extended usage captures the breadth and frequency of using different IS features and functions (p. 379)	Please indicate the extent to which you accomplish the following tasks by using student information system (SIS)? - Registration for courses (add/drop) - Access my grades - Access my transcript - View class schedule	5-point Likert scale (Strongly Disagree to Strongly Agree)

Integrative Use

(Shaded row represents definitions and measures used in this research)

Source	Definition	Measures	Scale
	Using systems for multi-tasking and in synergistic/holistic manner to enhance workflow (within own workflow and other people) (Self Developed)	1. **[IntUse1]** A large percentage (%) of my use of the LMS enhances the workflow linkages among my tasks 2. **[IntUse2]** I am able to use the LMS to improve the interaction among my work tasks 3. **[IntUse3]** My use of the LMS enables my tasks to fit better with other tasks in my workflow 4. **[IntUse4]** My use of the LMS to support my workflow can be described as integrated 5. **[IntUse5]** My use of the LMS improves the synergy among my work tasks 6. **[IntUse6]** Using the LMS enhances the integration between various tasks within my work processes **(Self-developed items,** *7-point Likert scale, Strongly Disagree to Strongly Agree*)	7-point Likert scale (Strongly Disagree to Strongly Agree)
(Saga & Zmud, 1994)	Using the technology in order to establish or enhance work flow linkages among a set of work tasks (p. 80)	No Measures	
(Ng & Kim, 2009)	Using the system to reinforce linkages among tasks (p. 3)	1. I use the ERP system for better connections among tasks 2. I use the ERP system to organize various tasks in an integrative manner 3. I use the ERP system to coordinate multiple tasks 4. I use the ERP system to handle related-tasks	Not Provided

Emergent Use

(Shaded row represents definitions and measures used in this research)

Source	Definition	Measures	Scale
	Using the IS in order to accomplish work tasks that were not feasible or recognized prior to the application of the technology to the work system (Saga and Zmud, 1994)	1. About what percentage (%) of the work you are doing with the LMS: • [**EmgUse1]** was **infeasible** to do before the introduction of the LMS? • **[EmgUse2]** is **new** *(i.e., work tasks or processes that did not exist before the introduction of the LMS)*? • **[EmgUse3]** is **innovative** *(i.e. unusual and effective)*? 2. A large percentage (%) of the work I am doing with the LMS: • **[EmgUse4]** was **infeasible** to do before the introduction of the LMS • **[EmgUse5]** is **new** *(i.e., work tasks or processes that did not exist before the introduction of the LMS)* • **[EmgUse6]** is **innovative** *(i.e. unusual and effective)* **(Self-developed items,** *7-point Likert scale, Strongly Disagree to Strongly Agree)*	See Column 3
(Saga & Zmud, 1994)	Using the technology in order to accomplish work tasks that were not feasible or recognized prior to the application of the technology to the work system (p. 80)	No Measures	
(Ng & Kim, 2009)	Using the system in an innovative manner to support tasks (p. 3)	1. I explore new uses of the ERP system to support my tasks 2. I often experiment with new ways of using the ERP system to accomplish my task 3. I often find new uses of the ERP system in performing my tasks 4. I use the ERP system in novel ways to complete my tasks	Not Provided

Infusion

(Shaded row represents definitions and measures used in this research)

Source	Definition	Measures	Scale
	The extent to which the user fully utilizes the system to enhance his/her productivity (Jones et al., 2002)	1. **[INF1]** I am using the LMS to its fullest potential for supporting my work (Jones et al., 2002) 2. **[INF2]** I am using all the capabilities of the LMS in the best fashion to help me on the job (Jones et al., 2002) 3. **[INF3]** I doubt that there are any better ways for me to use the LMS to support my work ((Jones et al., 2002) 4. **[INF4]** My use of the LMS on the job has been integrated and incorporated at the highest level (Jones et al., 2002) 5. **[INF5]** I am using the LMS in the best way possible to support my work (Self-Developed) 6. **[INF6]** My use of the LMS can be described as being at the highest level to support my work (Self-Developed) 7. **[INF7]** I doubt that I can extract any more benefits from using the LMS for my work (Self-Developed) *(7-point Likert scale, Strongly Disagree to Strongly Agree)*	7-point Likert scale (Strongly Disagree to Strongly Agree)
(Jones et al., 2002)	The extent to which the user fully utilizes the system to enhance his/her productivity" (Jones et al., 2002)	1. I am using [technology] to its fullest potential for supporting my own work 2. I am using all the capabilities of the [technology] in the best fashion to help me on the job 3. I doubt that there are any better ways for me to use [technology] to support my work 4. My use of [technology] on the job has been integrated and incorporated at the highest level	7-point Likert scale (Strongly Disagree to Strongly Agree)

Routinization

(Shaded row represents definitions and measures used in this research)

Source	Definition	Measures	Scale
	The extent to which the use of the technology has been integrated into the individual's normal work routine (Adapted from Sundaram et al., 2007)	My use of the LMS: • **[RTN1]** has been incorporated into my regular work schedule (Sundaram et al., 2007) • **[RTN2]** is pretty much integrated as part of my normal work routine (Sundaram et al., 2007) • **[RTN3]** is a normal part of my work (Sundaram et al., 2007) • **[RTN4]** is a natural part of the way I work (Sundaram et al., 2007) • [**RTN5]** have been routinized into my work (Self-Developed) *(7-point Likert scale, Strongly Disagree to Strongly Agree*	7-point Likert scale (Strongly Disagree to Strongly Agree)
(Sundaram et al., 2007)	The extent to which the use of the technology has been integrated into the salesperson's normal work routine (p. 110)	1. My use of [technology] has been incorporated into my regular work schedule 2. My use of [technology] is pretty much integrated as part of my normal work routine 3. My use of [technology] is a normal part of my work	7-point Likert scale (Strongly Disagree to Strongly Agree)
(Li et al., 2013)	Employees' using IS in a routine and standardized way to support their work (p. 3)	1. My use of the BIS has been incorporated into my regular work practices. 2. My use of the BIS is pretty much integrated as part of my normal work routine. 3. My use of the BIS is now a normal part of my work.	7-point Likert scale (Strongly Disagree to Strongly Agree)
(Schwarz, 2003)	The extent of which an individual's work patters are consistent with the technology	1. My use of [the technology] has been incorporated into my regular work schedule 2. My use of [the technology] is integrated as part of my normal work routine 3. My use of [the technology] [System] fits right into the way I work 4. My use of [the technology] is now a normal part of my work	Likert scale

UNIVERSITY OF CANTERBURY
Te Whare Wānanga o Waitaha
CHRISTCHURCH NEW ZEALAND

Accounting & Information System

Survey: Understanding Change in IT/Computer System Use

Please read the following before completing the survey.

You are invited to participate in a research project on IT/Computer System use by completing the following survey. The aim of this project is to understand how an individual's use of an IT/Computer System changes over time, regardless of **whether they are a basic or an advanced user**.

The project is being carried out as a requirement for a Doctor of Philosophy in Accounting and Information LMSs by Vanesa Tennant under the supervision of Dr. Annette Mills, who can be contacted at 03-364-2625 or by email at annette.mills@canterbury.ac.nz. She will be pleased to discuss any questions or concerns you may have about participation in the project.

The questionnaire is anonymous, and you will not be identified as a participant. You may withdraw your participation, including withdrawal of any information you have provided, up until your questionnaire has been added to the others collected. Because the survey is anonymous, your data cannot be retrieved once it has been combined with the other data collected.

By completing the questionnaire it will be understood that you have consented to participate in the project, and that you consent to publication of the results of the project with the understanding that anonymity will be preserved. You may request a copy of the results at the conclusion of the project. To receive a copy of the results, please email the research supervisor, Annette Mills at annette.mills@canterbury.ac.nz

Thank you for your participation in this research project.

This project has been reviewed and approved by the Department of Accounting and Information LMSs/ College of Business and Economics and the University of Canterbury Human Ethics Committee.

Complaints should be addressed to:
The Chair, UC Human Ethics Committee
University of Canterbury
Private Bag 4800, Christchurch
Email: human-ethics@canterbury.ac.nz

GENERAL INSTRUCTIONS

*This questionnaire should take about **30-35 minutes** to complete. For each question, please circle or check the response you feel is appropriate.*

Please answer **all** questions honestly and to the best of your knowledge. Your *first impressions* are the ones of *most* interest, so do not spend a lot of time on any one question. If you find it difficult to determine your exact answer, please give your *best estimate.*

Some questions may appear very similar. This is intentional to ensure greater statistical reliability and accuracy. We would therefore greatly appreciate it if you would answer all questions.

PART A

Instructions: For this survey we would like to ask your use of Learning Management Systems (LMS) (e.g. Moodle, Blackboard) for your work.

1. **Name the Learning Management System (LMS) that you use for your work:** __________

The remainder of this survey will use the term 'LMS' to refer to the Learning Management System you identified in Question 1 (above).

2. **Approximately, how long have you been using the LMS** *(including previous versions of the LMS)*?

☐ Less than 6 months ☐ 6 months to < 1 year ☐ 1-2 years ☐ 3-4 years
☐ 5-6 years ☐ 7-10 years ☐ More than 10 years

3. **In general, how would you rate your level of expertise with using the LMS:**

Basic 1 2 3 4 5 6 7 Advanced

4. **On average, how often do you use the LMS?**

Less than once a month	About once a month	A few times a month	About once a week	A few times a week	About once a day	Several times a day
☐	☐	☐	☐	☐	☐	☐

PART B: Experimenting with the LMS

Please <u>read</u> this section before answering the remaining questions.

In this section we want you to think back to when you first started using the LMS, compared to how you use it now: For example, you may have ***<u>experimented</u>*** *with:*

- ***different ways to do your work*** to accommodate the LMS, or
- ***using different features of the LMS*** to support your work.
  (e.g., Microsoft Word has features such as "track changes" and "mail merge", which may have been new to you or, you may have tried to use in a different way for your work.)

The following questions ask about ways you have **experimented with the LMS** *(for your work).*

Experimenting with Different Ways to do your Work:	*None at all* ↓			*A Moderate Amount* ↓			*A Great Amount* ↓
1. To accommodate the LMS in your work, how much have you experimented with:							
• **restructuring** the way you do your job**?**	1	2	3	4	5	6	7
• **creating new ways** to do your work?	1	2	3	4	5	6	7
• **creating innovative ways** *(i.e. unusual and effective)* to do your work?	1	2	3	4	5	6	7

Experimenting with Different Ways of Using the LMS:	*None at all* ↓			*A Moderate Amount* ↓			*A Great Amount* ↓
2. In using the LMS, how much have you experimented with**:**							
• **using new** features to support your work?	1	2	3	4	5	6	7
• **changing** how you use current features for your work?	1	2	3	4	5	6	7
• **substituting** (replacing) features you have been using with other LMS features to do your work?	1	2	3	4	5	6	7
• using various features in **new ways** to do your work?	1	2	3	4	5	6	7
• using different features in **innovative ways** *(i.e. unusual and effective)* for your work?	1	2	3	4	5	6	7

	Strongly Disagree ↓			*Neither* ↓			*Strongly Agree* ↓
3. Overall, thinking back to when I first started, I have **tried out many different ways** to use or accommodate the LMS in my job.	-3	-2	-1	0	+1	+2	+3

4. Overall, thinking back to when you first started, how much have you **experimented with different ways** of using or accommodating the LMS in your job?

None at all	1	2	3	4	5	6	7	A Great Amount
Not at all	1	2	3	4	5	6	7	To a Very Great Extent

Variations you have kept

The preceding questions asked about various ways you have experimented with the LMS *regardless of whether these have become a part of the way you do your work.*

Altogether we will **refer to these 'experiments' as 'Variations'** *(i.e. experiments with different ways to do your work to accommodate the LMS or different ways of using the LMS).*

The following questions pertain to how much of these **Variations have become a part of your work routine**.

Retaining Variations in how I work:	*None at all* ↓			*A Moderate Amount* ↓			*A Great Amount* ↓
5. To accommodate the LMS in your work, how much of the following *Variations* have you **<u>INCLUDED in your work routine</u>**:							
• **restructuring** in the way you do your job	1	2	3	4	5	6	7
• **new ways** you have created to do your work	1	2	3	4	5	6	7
• **innovative ways** *(i.e. unusual and effective)* you have created to do your work	1	2	3	4	5	6	7

Retaining Variations in how I Use the LMS:	*None at all* ↓			*A Moderate Amount* ↓			*A Great Amount* ↓
6. In using the LMS, how much of the following *Variations* have you **<u>INCLUDED in your work routine</u>**:							
• **new** features you have used to support your work?	1	2	3	4	5	6	7
• **changes** in how you use current features to do your work?	1	2	3	4	5	6	7
• **substitution** (replacement) of features you have been using with other LMS features to do your work?	1	2	3	4	5	6	7
• **new ways** of using various features to do your work?	1	2	3	4	5	6	7
• **innovative ways** *(i.e. unusual and effective)* of using different features to support your work?	1	2	3	4	5	6	7

	Strongly Disagree ↓			*Neither* ↓			*Strongly Agree* ↓
7. Overall, thinking back to when I first started, **most of the Variations I have experimented with *(in using or accommodating the LMS in my job)* have been <u>INCLUDED in my work routine</u>.**	-3	-2	-1	0	+1	+2	+3

8. Overall, thinking back to when you first started, **of the Variations you have experimented with *(in using or accommodating the LMS in your job)* how much have you <u>INCLUDED in your work routine</u>?**

None at all	1	2	3	4	5	6	7	A Great Amount
Not at all	1	2	3	4	5	6	7	To a Very Great Extent

9. Overall, thinking back to when you first started, **of the Variations you have tried out *(in using or accommodating the LMS in your job)* approximately what % have you <u>ADOPTED into your work routine</u>?** ____________ %

<u>Variations</u>*: Experiments with different ways to do your work to accommodate the LMS or different ways of using the LMS.*

10. All things considered, I am _____ with my <u>Variations</u>.

Very Dissatisfied	-3	-2	-1	0	+1	+2	+3	Very Satisfied
Very Displeased	-3	-2	-1	0	+1	+2	+3	Very Pleased
Very Frustrated	-3	-2	-1	0	+1	+2	+3	Very Contented
Very Disappointed	-3	-2	-1	0	+1	+2	+3	Very Delighted

Feedback

There are occasions when you may have received feedback on variations you have experimented with *(e.g. from supervisors, co-workers, the LMS itself, or self-reflection).*

The question below focus on times when you <u>receive feedback</u> on a Variation you have tried out.

11. On the whole, the feedback you receive when you experiment with a Variation is:

Bad	-3	-2	-1	0	+1	+2	+3	Good
Negative	-3	-2	-1	0	+1	+2	+3	Positive
Unfavourable	-3	-2	-1	0	+1	+2	+3	Favourable

***<u>Variations</u>**: Experiments with different ways to do your work to accommodate the LMS or different ways of using the LMS.*

PART C: Reasons for Experimenting with Variations

The following questions relate to reasons for experimenting with Variations

Reasons for Experimenting with Variations	*Strongly Disagree* ↓			*Neither* ↓			*Strongly Agree* ↓
1. **When experimenting with Variations:**							
• I get enjoyment from learning new things	-3	-2	-1	0	+1	+2	+3
• I receive satisfaction from acquiring new knowledge	-3	-2	-1	0	+1	+2	+3
• I get enjoyment from fulfilling my intrinsic need for fun	-3	-2	-1	0	+1	+2	+3
• I get pleasure from advancing my need for fun	-3	-2	-1	0	+1	+2	+3
• I receive satisfaction from supporting my internal need for enjoyment	-3	-2	-1	0	+1	+2	+3
• I get enjoyment from improving myself	-3	-2	-1	0	+1	+2	+3
• I experience satisfaction from the amount of self-actualization I gain	-3	-2	-1	0	+1	+2	+3

Reasons for Experimenting with Variations (cont.)	Strongly Disagree ↓			Neither ↓			Strongly Agree ↓
2. I am supposed to experiment with Variations	-3	-2	-1	0	+1	+2	+3
3. Experimenting with Variations is something that I have to do	-3	-2	-1	0	+1	+2	+3
4. I feel that I have to experiment with Variations	-3	-2	-1	0	+1	+2	+3
5. Experimenting with Variations is important for me	-3	-2	-1	0	+1	+2	+3
6. I believe that experimenting with Variations is good for me	-3	-2	-1	0	+1	+2	+3
7. Experimenting with Variations is of value to me	-3	-2	-1	0	+1	+2	+3
8. People who are important to me think that I should experiment with Variations	-3	-2	-1	0	+1	+2	+3
9. People whose opinions matter to me think that I should experiment with Variations	-3	-2	-1	0	+1	+2	+3

Motivation

10. My motivation to experiment with Variations based on **external needs** *(e.g. complying with management, work requirements, to avoid punishment or to receive rewards and incentives)* is:

Very Weak	1	2	3	4	5	6	7	Very Strong
Very Low	1	2	3	4	5	6	7	Very High

11. My motivation to experiment with Variations based on **internal needs** (e.g. *needs for fun, discovery, achievement, outdoing others, self-improvement*) is:

Very Weak	1	2	3	4	5	6	7	Very Strong
Very Low	1	2	3	4	5	6	7	Very High

Variations: *Experiments with different ways to do your work to accommodate the LMS or different ways of using the LMS.*

PART D: Resources for Experimenting with Variations

Perceived Resources	Strongly Disagree ↓			Neither ↓			Strongly Agree ↓
• I have the resources, opportunities, and knowledge I need to experiment with Variations	-3	-2	-1	0	+1	+2	+3
• There are no barriers to my experimenting with Variations	-3	-2	-1	0	+1	+2	+3
• I have access to the resources I need to experiment with Variations	-3	-2	-1	0	+1	+2	+3
• I am able to experiment with Variations if I want to	-3	-2	-1	0	+1	+2	+3
• In general, there are enough resources to support my experimenting with Variations	-3	-2	-1	0	+1	+2	+3

Training	Strongly Disagree ↓			Neither ↓			Strongly Agree ↓
1. **When it comes to my experimenting with Variations:**							
• I receive good training from my organization	-3	-2	-1	0	+1	+2	+3
• The kind of training provided by my organization is satisfactory	-3	-2	-1	0	+1	+2	+3

Peer Learning	Strongly Disagree ↓			Neither ↓			Strongly Agree ↓
2. **When it comes to my experimenting with Variations**:							
• My co-workers have been instrumental in helping me	-3	-2	-1	0	+1	+2	+3
• I have received a lot of guidance from my co-workers	-3	-2	-1	0	+1	+2	+3
• My co-workers have helped me a great deal	-3	-2	-1	0	+1	+2	+3
• I have learned a lot from my co-workers	-3	-2	-1	0	+1	+2	+3

Knowledge of the LMS and Workflows	Strongly Disagree ↓			Neither ↓			Strongly Agree ↓
3. **When it comes to my experimenting with Variations**:							
• I know the features of the LMS	-3	-2	-1	0	+1	+2	+3
• I understand all aspects of the LMS	-3	-2	-1	0	+1	+2	+3
• I understand how the task(s) I do fit into the overall work process	-3	-2	-1	0	+1	+2	+3
• I understand the overall work process that my task(s) is part of	-3	-2	-1	0	+1	+2	+3
4. I have a lot of background knowledge when it comes to my experimenting with Variations	-3	-2	-1	0	+1	+2	+3
5. I have the know-how for experimenting with Variations	-3	-2	-1	0	+1	+2	+3

Part E: Overall LMS Use

The following questions relate to your use of the LMS (as a whole) to support your work.

Percentage (%) of LMS Use

1. Of the **relevant features** of the LMS for supporting your work, about what % are you using? ________%
2. Of **all the features** that the LMS offers, about what % are you using to support your work? ________%
3. About what percentage (%) of the work you are doing with the LMS:
   - was **infeasible** to do before the introduction of the LMS? ________%
   - is **new** *(i.e., work tasks or processes that did not exist before the introduction of the LMS)*? ________%
   - is **innovative** *(i.e. unusual and effective)*? ________%

	Strongly Disagree ↓			Neither ↓			Strongly Agree ↓
4. I am using a large percentage (%) of the **relevant** features of the LMS to support my work.	-3	-2	-1	0	+1	+2	+3
5. I am using a large percentage (%) of **all the features** that the LMS offers to support my work.	-3	-2	-1	0	+1	+2	+3
6. A large percentage (%) of the work I am doing with the LMS:							
• was **infeasible** to do before the introduction of the LMS	-3	-2	-1	0	+1	+2	+3
• is **new** *(i.e., work tasks or processes that did not exist before the introduction of the LMS)*	-3	-2	-1	0	+1	+2	+3
• is **innovative** *(i.e. unusual and effective)*	-3	-2	-1	0	+1	+2	+3

Extent of LMS Use

	Strongly Disagree ↓			Neither ↓			Strongly Agree ↓
7. A large percentage (%) of my use of the LMS enhances the workflow linkages among my tasks	-3	-2	-1	0	+1	+2	+3
8. I am able to use the LMS to improve the interaction among my work tasks	-3	-2	-1	0	+1	+2	+3
9. My use of the LMS enables my tasks to fit better with other tasks in my workflow	-3	-2	-1	0	+1	+2	+3
10. My use of the LMS to support my workflow can be described as integrated	-3	-2	-1	0	+1	+2	+3
11. My use of the LMS improves the synergy among my work tasks	-3	-2	-1	0	+1	+2	+3
12. Using the LMS enhances the integration between various tasks within my work processes	-3	-2	-1	0	+1	+2	+3

13. My use of the LMS:

• has been incorporated into my regular work schedule	-3	-2	-1	0	+1	+2	+3
• is pretty much integrated as part of my normal work routine	-3	-2	-1	0	+1	+2	+3
• is a normal part of my work	-3	-2	-1	0	+1	+2	+3
• is a natural part of the way I work	-3	-2	-1	0	+1	+2	+3
• have been routinized into my work	-3	-2	-1	0	+1	+2	+3

Extent of LMS Use (cont'd)

Strongly Disagree ↓ *Neither* ↓ *Strongly Agree* ↓

14. **My use of the LMS:**

• I am using the LMS to its fullest potential for supporting my work	-3	-2	-1	0	+1	+2	+3
• I am using all the capabilities of the LMS in the best fashion to help me on the job	-3	-2	-1	0	+1	+2	+3
• I doubt that there are any better ways for me to use the LMS to support my work	-3	-2	-1	0	+1	+2	+3
• My use of the LMS on the job has been integrated and incorporated at the highest level	-3	-2	-1	0	+1	+2	+3
• I am using the LMS in the best way possible to support my work	-3	-2	-1	0	+1	+2	+3
• My use of the LMS can be described as being at the highest level to support my work	-3	-2	-1	0	+1	+2	+3
• I doubt that I can extract any more benefits from using the LMS for my work	-3	-2	-1	0	+1	+2	+3

Part F: General Questions and Demographics

Please be patient and assist us by answering the following set of questions. They refer to many different issues. You should answer these questions based on your 'gut' feeling. The exact answer is not important to us – but it is required for statistical calibration of all of the earlier questions.

Please indicate how much you agree or disagree with the following statements:	Strongly Disagree ↓			Neither ↓			Strongly Agree ↓
1. Music is important in my life.	-3	-2	-1	0	+1	+2	+3
2. Group meetings are usually inefficient.	-3	-2	-1	0	+1	+2	+3
3. People should shop at locally owned stores.	-3	-2	-1	0	+1	+2	+3
4. Mountains make a great destination for a vacation.	-3	-2	-1	0	+1	+2	+3

Demographics

Instructions: Responses to the following questions will be used for demographic purposes.

1. **What type of organisation do you work for?**

☐ Education ☐ Other *(Please Name)* ____

2. **What is the size of your organisation?**

☐ less than 20 employees ☐ 21-50 employees ☐ 51-100 employees

☐ 101-200 employees ☐ 201-500 employees ☐ 501-1000 employees ☐ over 1000 employees

3. **How long have you worked in your organisation?**

☐ less than 1 year ☐ 1-3 years ☐ 4-5 years ☐ 6-10 years ☐ over 10 years

4. **What area (or department) do you work in?** ___________________________________

5. **What is your current job position?** ____

6. **How long have you been in your current job position?**

☐ less than 1 year ☐ 1-3 years ☐ 4-5 years ☐ 6-10 years ☐ over 10 years

Personal Demographics

7. Gender: ☐ Male ☐ Female

8. What is your *age* group?

☐ Less than 20 years ☐ 20-25 years ☐ 26-35 years ☐ 36-45 years
☐ 46-55 years ☐ 56-65 years ☐ over 65 years

9. What is the <u>highest</u> level of *education that you have* achieved?

☐ Secondary School qualification ☐ Undergraduate Degree
☐ Certificate ☐ Postgraduate Degree
☐ Diploma ☐ Other (Please specify): ________________________

Comments
(Optional)

Thank you!